



Federal Register

**Monday,
February 26, 2007**

Part II

Environmental Protection Agency

**40 CFR Parts 59, 80, 85, and 86
Control of Hazardous Air Pollutants From
Mobile Sources; Final Rule**

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 59, 80, 85, and 86

[EPA-HQ-OAR-2005-0036; FRL-8278-4]

RIN 2060-AK70

Control of Hazardous Air Pollutants From Mobile Sources

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: EPA is adopting controls on gasoline, passenger vehicles, and portable fuel containers (primarily gas cans) that will significantly reduce emissions of benzene and other hazardous air pollutants (“mobile source air toxics”). Benzene is a known human carcinogen, and mobile sources are responsible for the majority of benzene emissions. The other mobile source air toxics are known or suspected to cause cancer or other serious health effects. We are limiting the benzene content of gasoline to an annual refinery average of 0.62% by volume, beginning in 2011. In addition, for gasoline, we are establishing a maximum average standard for refineries of 1.3% by volume beginning on July 1, 2012, which acts as an upper limit on gasoline benzene content when credits are used to meet the 0.62 volume % standard. We are also limiting exhaust emissions of hydrocarbons from passenger vehicles

when they are operated at cold temperatures. This standard will be phased in from 2010 to 2015. For passenger vehicles, we are also adopting evaporative emissions standards that are equivalent to those currently in effect in California. Finally, we are adopting a hydrocarbon emissions standard for portable fuel containers beginning in 2009, which will reduce evaporation and spillage of gasoline from these containers. These controls will significantly reduce emissions of benzene and other mobile source air toxics such as 1,3-butadiene, formaldehyde, acetaldehyde, acrolein, and naphthalene. There will be additional substantial benefits to public health and welfare because of significant reductions in emissions of particulate matter from passenger vehicles.

DATES: This rule is effective on April 27, 2007.

ADDRESSES: EPA has established a docket for this action under Docket ID No. EPA-HQ-2005-0036. All documents in the docket are listed on the www.regulations.gov Web site. Although listed in the index, some information is not publicly available, e.g., CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy form. Publicly available docket materials are

available either electronically through <http://www.regulations.gov> or in hard copy at the Air Docket, EPA/DC, EPA West, Room 3334, 1301 Constitution Ave., NW., Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566-1744, and the telephone number for the Air Docket is (202) 566-1742.

FOR FURTHER INFORMATION CONTACT: Mr. Chris Lieske, U.S. EPA, Office of Transportation and Air Quality, Assessment and Standards Division (ASD), Environmental Protection Agency, 2000 Traverwood Drive, Ann Arbor, MI 48105; telephone number: (734) 214-4584; fax number: (734) 214-4816; e-mail address: lieske.christopher@epa.gov, or Assessment and Standards Division Hotline; telephone number: (734) 214-4636; e-mail address: asinfo@epa.gov.

SUPPLEMENTARY INFORMATION:

Does This Action Apply to Me?

Entities potentially affected by this action are those that produce new motor vehicles, alter individual imported motor vehicles to address U.S. regulation, or convert motor vehicles to use alternative fuels. It will also affect you if you produce gasoline motor fuel or manufacture portable gasoline containers. Regulated categories include:

Category	NAICS codes ^a	SIC codes ^b	Examples of potentially affected entities
Industry	336111	3711	Motor vehicle manufacturers.
Industry	335312	3621	Alternative fuel vehicle converters.
	424720	5172	
	811198	7539	
	.....	7549	
Industry	811111	7538	Independent commercial importers.
	811112	7533	
	811198	7549	
Industry	324110	2911	Gasoline fuel refiners.
Industry	326199	3089	Portable fuel container manufacturers.
	332431	3411	

^a North American Industry Classification System (NAICS).

^b Standard Industrial Classification (SIC) system code.

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be regulated by this action. This table lists the types of entities that EPA is now aware could potentially be regulated by this action. Other types of entities not listed in the table could also be regulated. To determine whether your activities are regulated by this action, you should carefully examine the applicability criteria in 40 CFR parts 59,

80, 85, and 86. If you have any questions regarding the applicability of this action to a particular entity, consult the person listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

Outline of This Preamble

- I. Summary
- II. Overview of Final Rule
 - A. Light-Duty Vehicle Emission Standards
 - B. Gasoline Fuel Standards
 - C. Portable Fuel Container (PFC) Controls
- III. Why Is EPA Taking This Action?

- A. Statutory Requirements
 - 1. Clean Air Act Section 202(l)
 - 2. Clean Air Act Section 183(e)
 - 3. Energy Policy Act
- B. Public Health Impacts of Mobile Source Air Toxics (MSATs)
 - 1. What Are MSATs?
 - 2. Health Risk Associated With MSATs
 - a. National Cancer Risk
 - b. National Risk of Noncancer Health Effects
 - c. Exposure Near Roads
 - d. Exposure From Attached Garages

- 3. What Are the Health Effects of Air Toxics?
 - a. Overview of Potential Cancer and Noncancer Health Effects
 - b. Health Effects of Key MSATs
 - i. Benzene
 - ii. 1,3-Butadiene
 - iii. Formaldehyde
 - iv. Acetaldehyde
 - v. Acrolein
 - vi. Polycyclic Organic Matter (POM)
 - vii. Naphthalene
 - viii. Diesel Exhaust
 - c. Gasoline PM
 - d. Near-Roadway Health Effects
 - C. Ozone
 - 1. Background
 - 2. Health Effects of Ozone
 - 3. Plant and Ecosystem Effects of Ozone
 - 4. Current and Projected 8-hour Ozone Levels
 - D. Particulate Matter
 - 1. Background
 - 2. Health Effects of PM
 - 3. Welfare Effects of PM
 - a. Visibility
 - i. Background
 - ii. Current Visibility Impairment
 - iii. Future Visibility Impairment
 - b. Atmospheric Deposition
 - c. Materials Damage and Soiling
 - 4. Current and Projected PM_{2.5} Levels
 - 5. Current PM₁₀ Levels
- IV. What Are the Emissions, Air Quality, and Public Health Impacts of This Rule?
 - A. Emissions Impacts of All Rule Provisions Combined
 - 1. How Will MSAT Emissions Be Reduced?
 - 2. How Will VOC Emissions Be Reduced?
 - 3. How Will PM Emissions Be Reduced?
 - B. Emission Impacts by Provision
 - 1. Vehicle Controls
 - a. Volatile Organic Compounds (VOC)
 - b. Toxics
 - c. PM_{2.5}
 - 2. Fuel Benzene Standard
 - 3. PFC Standards
 - a. VOC
 - b. Toxics
 - C. What Are the Air Quality, Exposure, and Public Health Impacts of This Rule?
 - 1. Mobile Source Air Toxics
 - 2. Ozone
 - 3. PM
 - D. What Other Mobile Source Emissions Control Programs Reduce MSATs?
 - 1. Fuels Programs
 - a. Gasoline Sulfur
 - b. Gasoline Volatility
 - c. Diesel Fuel
 - d. Phase-Out of Lead in Gasoline
 - 2. Highway Vehicle and Engine Programs
 - 3. Nonroad Engine Programs
 - 4. Voluntary Programs
 - 5. Additional Programs Under Development That Will Reduce MSATs
 - a. On-Board Diagnostics for Heavy-Duty Vehicles Over 14,000 Pounds
 - b. Standards for Small Nonroad Spark-Ignition Engines
 - c. Standards for Locomotive and Marine Diesel Engines
 - E. How Do These Mobile Source Programs Satisfy the Requirements of Clean Air Act Section 202(l)?
 - V. New Light-duty Vehicle Standards
 - A. Introduction
 - B. What Cold Temperature Requirements Are We Adopting?
 - 1. Why Are We Adopting a New Cold Temperature NMHC Standard?
 - 2. What Are the New NMHC Exhaust Emissions Standards?
 - 3. Feasibility of the Cold Temperature NMHC Standards
 - a. Currently Available Emission Control Technologies
 - b. Feasibility Considering Current Certification Levels, Deterioration and Compliance Margin
 - c. Feasibility and Test Programs
 - 4. Standards Timing and Phase-In
 - a. Phase-In Schedule
 - b. Alternative Phase-In Schedules
 - 5. Certification Levels
 - 6. Credit Program
 - a. How Credits Are Calculated
 - b. Credits Earned Prior to Primary Phase-In Schedule
 - c. How Credits Can Be Used
 - d. Discounting and Unlimited Life
 - e. Deficits Can Be Carried Forward
 - f. Voluntary Heavy-Duty Vehicle Credit Program
 - 7. Additional Vehicle Cold Temperature Standard Provisions
 - a. Applicability
 - b. Useful Life
 - c. High Altitude
 - d. In-Use Standards for Vehicles Produced During Phase-In
 - 8. Monitoring and Enforcement
 - C. What Evaporative Emissions Standards Are We Finalizing?
 - 1. Current Controls and Feasibility of the New Standards
 - 2. Evaporative Standards Timing
 - 3. Timing for Flex Fuel Vehicles
 - 4. In-Use Evaporative Emission Standards
 - 5. Existing Differences Between California and Federal Evaporative Emission Test Procedures
 - D. Additional Exhaust Control Under Normal Conditions
 - E. Vehicle Provisions for Small Volume Manufacturers
 - 1. Lead Time Transition Provisions
 - 2. Hardship Provisions
 - 3. Special Provisions for Independent Commercial Importers (ICIs)
 - VI. Gasoline Benzene Control Program
 - A. Description of and Rationale for the Gasoline Benzene Control Program
 - 1. Gasoline Benzene Content Standard
 - a. Description of the Average Benzene Content Standard
 - b. Why Are We Finalizing a Benzene Content Standard?
 - i. Standards That Would Include Toxics Other Than Benzene
 - ii. Control of Gasoline Sulfur and/or Volatility for MSAT Reduction
 - iii. Diesel Fuel Changes
 - c. Why Are We Finalizing a Level of 0.62 vol% for the Average Benzene Standard?
 - i. General Technological Feasibility of Benzene Control
 - ii. Appropriateness of the 0.62 vol% Average Benzene Content Standard
 - iii. Timing of the Average Standard
 - d. Upper Limit Benzene Standard
 - 2. Description of the Averaging, Banking, and Trading (ABT) Program
 - a. Overview
 - b. Credit Generation
 - i. Eligibility
 - ii. Early Credit Generation
 - iii. Standard Credit Generation
 - c. Credit Use
 - i. Early Credit Life
 - ii. Standard Credit Life
 - iii. Consideration of Unlimited Credit Life
 - iv. Credit Trading Provisions
 - 3. Provisions for Small Refiners and Refiners Facing Hardship Situations
 - a. Provisions for Small Refiners
 - i. Definition of Small Refiner for Purposes of the MSAT2 Small Refiner Provisions
 - ii. Small Refiner Status Application Requirements
 - iii. Small Refiner Provisions
 - iv. The Effect of Financial and Other Transactions on Small Refiner Status and Small Refiner Relief Provisions
 - b. Provisions for Refiners Facing Hardship Situations
 - i. Temporary Waivers Based on Extreme Hardship Circumstances
 - ii. Temporary Waivers Based on Unforeseen Circumstances
 - c. Option for Early Compliance in Certain Circumstances
 - B. How Will the Gasoline Benzene Standard Be Implemented?
 - 1. General Provisions
 - 2. Small Refiner Status Application Requirements
 - 3. Administrative and Enforcement Provisions
 - a. Sampling/Testing
 - b. Recordkeeping/Reporting
 - C. How Will the Program Relate to Other Fuel-Related Toxics Programs?
 - D. How Does This Program Satisfy the Statutory Requirements of Clean Air Act Section 202(l)(2)?
 - VII. Portable Fuel Containers
 - A. What Are the New HC Emissions Standards for PFCs?
 - 1. Description of Emissions Standard
 - 2. Determination of Best Available Control
 - 3. Diesel, Kerosene and Utility Containers
 - 4. Automatic Shut-Off
 - B. Timing of Standard
 - C. What Test Procedures Would Be Used?
 - 1. Diurnal Test
 - 2. Preconditioning To Ensure Durable In-Use Control
 - a. Durability Cycles
 - b. Preconditioning Fuel Soak
 - c. Spout Actuation
 - D. What Certification and In-Use Compliance Provisions Is EPA Adopting?
 - 1. Certification
 - 2. Emissions Warranty and In-Use Compliance
 - 3. Labeling
 - E. How Would State Programs Be Affected by EPA Standards?
 - F. Provisions for Small PFC Manufacturers
 - 1. First Type of Hardship Provision
 - 2. Second Type of Hardship Provision
 - VIII. What Are the Estimated Impacts of the Rule?
 - A. Refinery Costs of Gasoline Benzene Reduction
 - 1. Methodology
 - a. Overview of the Benzene Program Cost Methodology

- b. Changes to the Cost Estimation Methodology Used in the Proposed Rule
- c. Linear Programming Cost Model
- d. Refinery-by-Refinery Cost Model
- e. Price of Chemical Grade Benzene
- 2. Summary of Costs
 - a. Nationwide Costs of the Final Benzene Control Program
 - b. Regional Costs
 - c. Refining Industry Cost Study
 - B. What Are the Vehicle Cost Impacts?
 - C. What Are the PFC Cost Impacts?
 - D. Cost per Ton of Emissions Reduced
 - E. Benefits
 - 1. Unquantified Health and Environmental Benefits
 - 2. Quantified Human Health and Environmental Effects of the Final Cold Temperature Vehicle Standard
 - 3. Monetized Benefits
 - 4. What Are the Significant Limitations of the Benefit Analysis?
 - 5. How Do the Benefits Compare to the Costs of the Final Standards?
 - F. Economic Impact Analysis
 - 1. What Is an Economic Impact Analysis?
 - 2. What Is the Economic Impact Model?
 - 3. What Economic Sectors Are Included in This Economic Impact Analysis?
 - 4. What Are the Key Features of the Economic Impact Model?
 - 5. What Are the Key Model Inputs?
 - 6. What Are the Results of the Economic Impact Modeling?
- IX. Public Participation
- X. Statutory and Executive Order Reviews
 - A. Executive Order 12866: Regulatory Planning and Review
 - B. Paperwork Reduction Act
 - C. Regulatory Flexibility Act (RFA), as Amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), 5 U.S.C. 601 *et seq.*
 - 1. Overview
 - 2. The Need for and Objectives of This Rule
 - 3. Summary of the Significant Issues Raised by the Public Comments
 - 4. Summary of Regulated Small Entities
 - a. Highway Light-Duty Vehicles
 - b. Gasoline Refiners
 - c. Portable Fuel Container Manufacturers
 - 5. Description of the Reporting, Recordkeeping, and Other Compliance Requirements of the Rule
 - 6. Relevant Federal Rules
 - 7. Steps Taken To Minimize the Significant Economic Impact on Small Entities
 - a. Significant Panel Findings
 - b. Outreach With Small Entities (and the Panel Process)
 - c. Small Business Flexibilities
 - i. Highway Light-Duty Vehicles
 - ii. Gasoline Refiners
 - iii. Portable Fuel Containers
 - D. Unfunded Mandates Reform Act
 - E. Executive Order 13132: Federalism
 - F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments
 - G. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks
 - H. Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution, or Use

- I. National Technology Transfer Advancement Act
- J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations
- K. Congressional Review Act
- XI. Statutory Provisions and Legal Authority

I. Summary

Mobile sources emit air toxics (also known as “hazardous air pollutants”) that can cause cancer and other serious health effects. Mobile sources contribute significantly to the nationwide risk from breathing outdoor sources of air toxics. Mobile sources were responsible for about 44% of outdoor toxic emissions, almost 50% of the cancer risk, and 74% of the noncancer risk according to EPA’s National-Scale Air Toxics Assessment (NATA) for 1999. In addition, people who live or work near major roads or live in homes with attached garages are likely to have higher exposures and risk, which are not reflected in NATA.

According to NATA for 1999, there are a few mobile source air toxics that pose the greatest risk based on current information about ambient levels and exposure. These include benzene, 1,3-butadiene, formaldehyde, acrolein, naphthalene, and polycyclic organic matter (POM). All of these compounds are gas-phase hydrocarbons except POM, which appears in the gas and particle phases. Benzene is the most significant contributor to cancer risk from all outdoor air toxics, according to NATA for 1999. NATA does not include a quantitative estimate of cancer risk for diesel exhaust, but it concludes that diesel exhaust is a mixture of pollutants that collectively poses one of the greatest relative cancer risks when compared with the other individual pollutants assessed. Although we expect significant reductions in mobile source air toxics in the future, cancer and noncancer health risks will remain a public health concern, and exposure to benzene will remain the largest contributor to this risk.

In this rule, we are finalizing standards for passenger vehicles, gasoline, and portable fuel containers (typically gas cans). Specifically, we are finalizing standards for:

- exhaust hydrocarbon emissions from passenger vehicles during cold temperature operation;
- evaporative hydrocarbon emissions from passenger vehicles;
- the benzene content of gasoline; and
- hydrocarbon emissions from portable fuel containers that would reduce evaporation, permeation, and spillage from these containers.

These standards will significantly reduce emissions of the many air toxics that are hydrocarbons, including benzene, 1,3-butadiene, formaldehyde, acetaldehyde, acrolein, and naphthalene. The fuel benzene standards and hydrocarbon standards for vehicles and portable fuel containers will together reduce total emissions of air toxics by 330,000 tons in 2030, including 61,000 tons of benzene. As a result of this final rule, in 2030 passenger vehicles will emit 45% less benzene, gas cans will emit almost 80% less benzene, and gasoline will have 38% less benzene overall. Mobile sources were responsible for over 70% of benzene emissions in 1999.

The reductions in mobile source air toxics emissions will reduce exposure and predicted risk of cancer and noncancer health effects, including in environments where exposure and risk may be highest, such as near roads, in vehicles, and in homes with attached garages. Nationwide, the cancer risk attributable to total MSATs emitted by all mobile sources will be reduced by 30%, and the risk from mobile source benzene will be reduced by 37%. At 2030 exposure levels, the highway vehicle contribution to MSAT cancer risk will be reduced on average 36% across the U.S., and the highway vehicle contribution to benzene cancer risk will be reduced on average by 43% across the U.S. Nationwide, the mobile source contribution to the respiratory hazard index will be reduced by 23%. In addition, the hydrocarbon reductions from the vehicle and gas can standards will reduce VOC emissions (which are precursors to ozone and PM_{2.5}) by over 1.1 million tons in 2030. The vehicle standards will reduce direct PM_{2.5} emissions by over 19,000 tons in 2030 and will also reduce secondary formation of PM_{2.5}. Although ozone and PM_{2.5} are considered criteria pollutants rather than “air toxics,” reductions in ozone and PM_{2.5} are nevertheless important co-benefits of this proposal.

Section I.B.2 of this preamble provides more discussion of the public health and environmental impacts of mobile source air toxics, ozone, and PM. Details on health effects, emissions, exposure, and cancer risks are also located in Chapters 1–3 of the Regulatory Impact Analysis (RIA) for this rule.

We estimate that the benefits of this rule will be about \$6 billion in 2030, based on the direct PM_{2.5} reductions from the vehicle standards, plus unquantified benefits from reductions in mobile source air toxics and VOC. We estimate that the annual net social costs of this rule will be about \$400 million

in 2030 (expressed in 2003 dollars). These net social costs include the value of fuel savings from the proposed gas can standards, which will be worth about \$92 million in 2030.

The rule will have an average cost of 0.27 cents per gallon of gasoline, less than \$1 per vehicle, and less than \$2 per gas can. The reduced evaporation from gas cans will result in fuel savings that will more than offset the increased cost for the gas can. In 2030, the long-term cost per ton of the standards (in combination, and including fuel savings) will be \$1,100 per ton of total mobile source air toxics reduced; \$5,900 per ton of benzene reduced; and no cost for the hydrocarbon and PM reductions (because we expect the vehicle standards will have no cost in 2020 and beyond). Section VIII of the preamble and Chapters 8–13 of the RIA provide more details on the costs, benefits, and economic impacts of the standards. The impacts on small entities and the flexibilities we are finalizing are discussed in section X of this preamble and Chapter 14 of the RIA.

II. Overview of Final Rule

A. Light-Duty Vehicle Emission Standards

As described in more detail in section V, we are adopting new standards for both exhaust and evaporative emissions from passenger vehicles. The new exhaust emissions standards will significantly reduce non-methane hydrocarbon (NMHC) emissions from passenger vehicles at cold temperatures. These hydrocarbons include many mobile source air toxics (including benzene), as well as VOC.

As we discussed in the proposal, current vehicle emission standards are based on testing of NMHC that is generally performed at 75 °F. Recent research and analysis indicates that these standards are not resulting in robust control of NMHC at lower temperatures. We believe that cold temperature NMHC control can be substantially improved using the same technological approaches that are generally already being used in the Tier 2 vehicle fleet to meet the stringent standards at 75 °F. These cold-temperature NMHC controls will also result in lower direct PM emissions at cold temperatures.

Accordingly, consistent with the proposal, we are adopting a new NMHC exhaust emissions standard at 20 °F for light-duty vehicles, light-duty trucks, and medium-duty passenger vehicles. Vehicles at or below 6,000 pounds gross vehicle weight rating (GVWR) will be subject to a sales-weighted fleet average

NMHC level of 0.3 grams/mile. Vehicles between 6,000 and 8,500 pounds GVWR and medium-duty passenger vehicles will be subject to a sales-weighted fleet average NMHC level of 0.5 grams/mile. For lighter vehicles, the standard will phase in between 2010 and 2013. For heavier vehicles, the new standards will phase in between 2012 and 2015. The standards include a credit program and other provisions designed to provide flexibility to manufacturers, especially during the phase-in periods. These provisions are designed to allow the earliest possible phase-in of standards and help minimize costs and ease the transition to new standards. These standards in combination are expected to lead to emissions control over a wide range of in-use temperatures, and not just at 20 °F and 75 °F.

We are also establishing, as proposed, a set of nominally more stringent evaporative emission standards for all light-duty vehicles, light-duty trucks, and medium-duty passenger vehicles. The standards are equivalent to California's Low Emission Vehicle II (LEV II) standards, and they reflect the evaporative emissions levels that are already being achieved nationwide. The standards codify the approach that most manufacturers are already taking for 50-state evaporative systems, and thus prevent backsliding in the future. The evaporative emission standards will take effect in 2009 for lighter vehicles and in 2010 for the heavier vehicles.

Section V of this preamble provides details on the exhaust and evaporative vehicle standards.

B. Gasoline Fuel Standards

As we proposed, we are limiting the benzene content of all gasoline, both reformulated and conventional. Beginning January 1, 2011, refiners must meet a refinery average gasoline benzene content standard of 0.62% by volume on all their gasoline. The program is described in more detail in section VI of this preamble. The standard does not apply to gasoline produced and/or sold for use in California because such gasoline is already covered under California's Phase 3 Reformulated Gasoline (Ca3RFG) program.

The benzene content standard, in combination with the existing gasoline sulfur standard, will result in air toxics emissions reductions that are greater than required under all existing gasoline toxics programs. As a result, upon full implementation in 2011, the regulatory provisions for the benzene control program will become the regulatory mechanism used to implement the reformulated gasoline (RFG) and Anti-

dumping annual average toxics performance and benzene content requirements. The current RFG and Anti-dumping annual average provisions thus will be replaced by this benzene control program. This benzene control program will also replace the requirements of the 2001 MSAT rule ("MSAT1"). In addition, the program will satisfy certain fuel MSAT conditions of the Energy Policy Act of 2005 and obviate the need to revise toxics baselines for reformulated gasoline otherwise required by that Act. In all of these ways, the existing national fuel-related MSAT regulatory program will be significantly consolidated and simplified.

We are finalizing a nationwide ABT program that allows refiners and importers to choose the most economical compliance strategy (investment in technology, credits, or both) for meeting the 0.62 vol% annual average standard. From 2007–2010, refiners can generate "early credits" by making qualifying benzene reductions earlier than required. Beginning in 2011 and continuing indefinitely, refiners and importers can generate "standard credits" by producing/importing gasoline with benzene levels below 0.62 volume percent (vol%) on an annual average basis. Credits may be used interchangeably towards company compliance with the 0.62 vol% standard, "banked" for future use, and/or transferred nationwide to other refiners/importers subject to the standard. In addition to the 0.62 vol% standard, refiners and importers must also meet a 1.3 vol% maximum average benzene standard beginning July 1, 2012. To comply with the maximum average standard, gasoline produced by a refinery or imported by an importer may not exceed 1.3 vol% benzene on an annual average basis.

The ABT program allows us to set a numerically more stringent benzene standard than would otherwise be achievable (within the meaning of Clean Air Act section 202(l)(2)). The ABT program also allows implementation to occur earlier. Under this benzene content standard and ABT program, gasoline in all areas of the country will have lower benzene levels than they have today. Overall benzene levels will be 38% lower. This will reduce benzene emissions and exposure nationwide.

The program includes special provisions for refiners facing hardship. Refiners approved as "small refiners" are eligible for certain temporary relief provisions. In addition, any refiner facing extreme unforeseen circumstances or extreme hardship

circumstances can apply for similar temporary relief.

C. Portable Fuel Container (PFC) Controls

Portable fuel containers, such as gas cans and diesel and kerosene containers, are consumer products used to refuel a wide variety of equipment, including lawn and garden equipment, recreational equipment, and passenger vehicles that have run out of gas. As described in section VII, we are adopting standards for these containers that would reduce hydrocarbon emissions from evaporation, permeation, and spillage. The program we are finalizing is consistent with the proposal, except that instead of applying only to gasoline containers, it will also apply to diesel and kerosene containers. These standards will significantly reduce emissions of benzene and other gaseous toxics, as well as VOC. VOC is an ozone precursor, and certain aromatic species are believed to contribute to secondary organic PM_{2.5}.

We are finalizing a performance-based standard of 0.3 grams per gallon per day of hydrocarbons, determined based on the emissions from the can over a diurnal test cycle specified in the rule. The standard applies to containers manufactured on or after January 1, 2009. We are also establishing test procedures and a certification and compliance program, in order to ensure that containers meet the emission standard over a range of in-use conditions. The standards are based on the performance of best available control technologies, such as durable permeation barriers, automatically closing spouts, and cans that are well-sealed, and the standards will result in the use of these control technologies.

California implemented an emissions control program for gas cans in 2001, and since then, several other states have adopted the program. Last year, California adopted a revised program, which will take effect July 1, 2007. The revised California program is very similar to the program we are finalizing. Although a few aspects of the programs are different, we believe manufacturers will be able to meet both EPA and California requirements with the same container designs, resulting in equivalent emission reductions.

III. Why Is EPA Taking This Action?

People experience elevated risk of cancer and other noncancer health effects from exposure to air toxics. Mobile sources are responsible for a significant portion of this risk. For example, benzene is the most significant

contributor to cancer risk from all outdoor air toxics¹, and most of the nation's benzene emissions come from mobile sources. These risks vary depending on where people live and work and the kinds of activities in which they engage. People who live or work near major roads, people that spend a large amount of time in vehicles or work with motorized equipment, and people living in homes with attached garages are likely to have higher exposures and higher risks. Although we expect significant reductions in mobile source air toxics in the future, predicted cancer and noncancer health risks are likely to remain a public health concern. Benzene will likely remain the largest contributor to this risk. In addition, some mobile source air toxics contribute to the formation of ozone and PM_{2.5}, which contribute to serious public health problems. Section III.B of this preamble discusses the risks posed by outdoor toxics now and in the future. Sections III.C and III.D discuss the health and welfare effects of ozone and PM, respectively. The controls in this rule will significantly reduce exposure to emissions of mobile source air toxics (and reduce exposure to ozone and PM_{2.5} as well), thus reducing these public health concerns.

A. Statutory Requirements

1. Clean Air Act Section 202(l)

Section 202(l)(2) of the Clean Air Act requires EPA to set standards to control hazardous air pollutants ("air toxics") from motor vehicles², motor vehicle fuels, or both. These standards must reflect the greatest degree of emission reduction achievable through the application of technology which will be available, taking into consideration the motor vehicle standards established under section 202(a) of the Act, the availability and cost of the technology, and noise, energy and safety factors, and lead time. The standards are to be set under Clean Air Act sections 202(a)(1) or 211(c)(1), and they are to apply, at a minimum, to benzene and formaldehyde emissions.

Section 202(a)(1) of the Clean Air Act directs EPA to set standards for new motor vehicles or new motor vehicle engines which EPA judges to cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. We are issuing

¹ Based on quantitative estimates of risk, which do not include risks associated with diesel particulate matter and diesel exhaust organic gases.

² "Motor vehicles" is a term of art, defined in Clean Air Act section 216(2) as "any self-propelled vehicle designed for transporting persons or property on a street or highway."

the vehicle emissions standards under this authority in conjunction with section 202(l)(2).

Section 211(c)(1)(A) of the Clean Air Act authorizes EPA (among other things) to control the manufacture of fuel if any emission product of such fuel causes or contributes to air pollution which may reasonably be anticipated to endanger public health or welfare. We are issuing the benzene standard for gasoline under this authority in conjunction with section 202(l)(2).

Clean Air Act section 202(l)(2) also requires EPA to revise its regulations controlling hazardous air pollutants from motor vehicles and fuels, "from time to time." EPA's first rule under Clean Air Act section 202(l) was published on March 29, 2001, entitled, "Control of Emissions of Hazardous Air Pollutants from Mobile Sources" (66 FR 17230). That rule committed to additional rulemaking that would evaluate the need for and feasibility of additional controls. Today's final rule fulfills that commitment.

2. Clean Air Act Section 183(e)

Clean Air Act section 183(e)(3) requires EPA to list categories of consumer or commercial products that the Administrator determines, based on an EPA study of VOC emissions from such products, contribute at least 80 percent of the VOC emissions from such products in areas violating the national ambient air quality standard for ozone. EPA promulgated this list at 60 FR 15264 (March 23, 1995), but it did not consider or list portable fuel containers. After analyzing these containers' emissions inventory impacts, we recently published a **Federal Register** notice that added portable fuel containers to the list of consumer products to be regulated.³ EPA is required to develop rules reflecting "best available controls" to reduce VOC emissions from the listed products. "Best available controls" are defined in section 183(e)(1)(A) as follows:

The term "best available controls" means the degree of emissions reduction that the Administrator determines, on the basis of technological and economic feasibility, health, environmental, and energy impacts, is achievable through the application of the most effective equipment, measures, processes, methods, systems, or techniques, including chemical reformulation, product or feedstock substitution, repackaging, and directions for use, consumption, storage, or disposal.

Section 183(e)(4) also allows these standards to be implemented by means

³ 71 FR 28320, May 16, 2006, "Consumer and Commercial Products: Schedule for Regulation".

of “any system or systems of regulation as the Administrator may deem appropriate, including requirements for registration and labeling, self-monitoring and reporting * * * concerning the manufacture, processing, distribution, use, consumption, or disposal of the product.” We are issuing a hydrocarbon standard for portable fuel containers under the authority of section 183(e).

3. Energy Policy Act

Section 1504(b) of the Energy Policy Act of 2005 requires EPA to adjust the toxics emissions baselines for individual refineries for reformulated gasoline to reflect 2001–2002 fuel qualities. However, the Act provides that this action becomes unnecessary if EPA takes action which results in greater overall reductions of toxics emissions from vehicles in areas with reformulated gasoline. As described in section VI of this preamble, we believe the benzene content standard we are finalizing today will in fact result in greater overall reductions than would be achieved by adjusting the individual baselines under the Energy Policy Act. Accordingly, under the provisions of the Energy Policy Act, this rule obviates the need for readjusting emissions baselines for reformulated gasoline.

B. Public Health Impacts of Mobile Source Air Toxics (MSATs)

1. What Are MSATs?

Section 202(l) refers to “hazardous air pollutants from motor vehicles and motor vehicle fuels.” We use the term “mobile source air toxics (MSATs)” to refer to compounds that are emitted by mobile sources and have the potential for serious adverse health effects. Some MSATs are known or suspected to cause cancer. Some of these pollutants are also known to have adverse health effects on people’s respiratory, cardiovascular, neurological, immune, reproductive, or other organ systems, and they may also have developmental effects. Some may pose particular hazards to more susceptible and sensitive populations, such as pregnant women, children, the elderly, or people with pre-existing illnesses.

Some MSATs of particular concern include benzene, 1,3-butadiene, formaldehyde, acrolein, naphthalene, polycyclic organic matter, and diesel particulate matter and diesel exhaust organic gases. These are compounds that EPA’s National-Scale Air Toxics Assessment (NATA) for 1999⁴ identifies as the most significant contributors to

cancer and noncancer health risk from breathing outdoor air toxics, and that have a significant contribution from mobile sources. Our understanding of what compounds pose the greatest risk will evolve over time, based on our understanding of the ambient levels and health effects associated with the compounds.

EPA has compiled a Master List of Compounds Emitted by Mobile Sources, based on an extensive review of the literature on exhaust and evaporative emissions from onroad and nonroad equipment. The list currently includes approximately 1,000 compounds, and it is available in the public docket for this rule and on the Web (<http://www.epa.gov/otaq/toxics.htm>). Chapter 1 of the RIA provides a detailed discussion of information sources for identifying those compounds that have the potential for serious adverse health effects (i.e., could be considered “MSATs”). This discussion includes a list of those compounds that are emitted by mobile sources and listed in EPA’s Integrated Risk Information System (IRIS).

MSATs are emitted by motor vehicles, nonroad engines (such as lawn and garden equipment, farming and construction equipment, locomotives, and ships), aircraft, and their fuels. MSATs are emitted as a result of various processes. Some MSATs are present in fuel or fuel additives and are emitted to the air when the fuel evaporates or passes through the engine. Some MSATs are formed through engine combustion processes. Some compounds, like formaldehyde and acetaldehyde, are also formed through a secondary process when other mobile source pollutants undergo chemical reactions in the atmosphere. Finally, some air toxics, such as metals, result from engine wear or from impurities in oil or fuel.

There are other sources of air toxics, including stationary sources, such as power plants, factories, oil refineries, dry cleaners, gas stations, and small manufacturers. They can also be produced by combustion of wood and other organic materials. There are also indoor sources of air toxics, such as solvent evaporation and outgassing from furniture and building materials.

2. Health Risk Associated With MSATs

EPA’s National-Scale Air Toxics Assessment (NATA) for 1999 provides some perspective on the average risk of cancer and noncancer health effects associated with breathing air toxics from outdoor sources, and the contribution of

mobile sources to these risks.^{5,6} NATA assessed 177 pollutants. It is worth noting that NATA does not include indoor sources of air toxics. Also, it assumes uniform outdoor concentrations within a census tract, and therefore does not reflect elevated concentrations and exposures near roadways or other sources within a census tract. Additional limitations and uncertainties associated with NATA are discussed in Section 3.2.1.3 of the RIA. Nevertheless, its findings are useful in providing a perspective on the magnitude of risks posed by outdoor sources of air toxics generally, and in identifying what pollutants and sources are important contributors to these health risks. Some of NATA’s findings are discussed in the paragraphs below.

For this rule, EPA also performed a national-scale assessment for 1999 and future years using the same modeling tools and approach as the 1999 NATA, but with updated emissions inventories and an updated exposure model. The exposure model accounts for higher toxics concentrations near roads. This updated national-scale analysis examined only those toxics that are emitted by mobile sources (i.e., a subset of the 177 pollutants included in NATA). However, the analysis includes all sources of those pollutants, including mobile, stationary, and area sources. The analysis is discussed in detail in Chapter 3 of the RIA, and some highlights of the findings are discussed immediately below.

In addition to national-scale analysis, we have also evaluated more refined local-scale modeling, measured ambient concentrations, personal exposure measurements, and other data. This information is discussed in detail in Chapter 3 of the RIA. These data collectively show that while levels of air toxics are decreasing, potential public health risks remain a concern, and ambient levels and personal exposure vary significantly. These data indicate that concentrations of benzene and other air toxics can be higher near high-traffic roads, inside vehicles, and in homes with attached garages.

a. National Cancer Risk

According to NATA, the average national cancer risk in 1999 from all outdoor sources of air toxics was estimated to be 42 in a million. That is, 42 out of one million people would be

⁵ <http://www.epa.gov/ttn/atw/nata1999/>.

⁶ NATA does not include a quantitative estimate of cancer risk for diesel particulate matter and diesel exhaust organic gases. EPA has concluded that while diesel exhaust is likely to be a human carcinogen, available data are not sufficient to develop a confident estimate of cancer unit risk.

⁴ <http://www.epa.gov/ttn/atw/nata1999/>.

expected to contract cancer from a lifetime of breathing air toxics at 1999 levels. Mobile sources were responsible for 44% of outdoor toxic emissions and almost 50% of the cancer risk. Benzene is the largest contributor to cancer risk of all 133 pollutants quantitatively assessed in the 1999 NATA, and mobile sources are the single largest source of ambient benzene.

According to the national-scale analysis performed for this rule, the national average cancer risk in 1999 from breathing outdoor sources of MSATs was about 25 in a million.⁷ Over 224 million people in 1999 were exposed to a risk level above 10 in a million due to chronic inhalation exposure to MSATs. About 130 million people in 1999 were exposed to a risk level above 10 in a million due to chronic inhalation exposure to benzene alone. Mobile sources were responsible for over 70% of benzene emissions in 1999.

Although air toxics emissions are projected to decline in the future as a result of standards EPA has previously adopted, cancer risk will continue to be a public health concern. Without additional controls, the predicted national average cancer risk from MSATs in 2030 is predicted to be above 20 in a million. In fact, in 2030 there will be more people exposed to levels of MSATs that result in the highest levels of risk. For instance, the number of Americans above the 10 in a million cancer risk level from exposure to MSATs is projected to increase from 223 million in 1999 to 272 million in 2030. Mobile sources will continue to be a significant contributor to risk in the future, accounting for 43% of total air toxic emissions in 2020, and 55% of benzene emissions.

b. National Risk of Noncancer Health Effects

According to national-scale modeling for 1999 done for this rule, nearly the entire U.S. population was exposed to an average level of air toxics that has the potential for adverse respiratory health effects (noncancer).⁸ We estimated this will continue to be the case in 2030, even though toxics levels will be lower.

Mobile sources were responsible for 74% of the noncancer (respiratory) risk from outdoor air toxics in the 1999 NATA. The majority of this risk was from acrolein, and formaldehyde also

contributed to the risk of respiratory health effects.⁹

Although not included in NATA's estimates of noncancer risk, PM from gasoline and diesel mobile sources contributes significantly to the health effects associated with ambient PM, for which EPA has established National Ambient Air Quality Standards. There are extensive human data showing a wide spectrum of adverse health effects associated with exposure to ambient PM.¹⁰

c. Exposure Near Roads

A substantial number of modeling assessment and air quality monitoring studies show elevated concentrations of multiple MSATs in close proximity to major roads. Exposure studies also indicate that populations spending time near major roadways likely experience elevated personal exposures to motor vehicle-related pollutants. In addition, these populations may experience exposures to differing physical and chemical compositions of certain air toxic pollutants depending on the amount of time spent in close proximity to motor vehicle emissions. Chapter 3.1 of the RIA provides a detailed discussion of air quality monitoring, personal exposure monitoring, and modeling assessments near major roadways.

As part of the analyses underlying the final rule, we employed a new version of the Hazardous Air Pollutant Exposure Model (HAPEM), the exposure model used in NATA. HAPEM6 explicitly accounts for the gradient in outdoor concentrations that occurs near major roads, and the fraction of the population living near major roads.¹¹ The HAPEM6 analysis highlights the fact that residence near a major road is a substantial contributor to overall differences in exposure to directly-emitted MSATs. As an example, while the average of within-tract median annual census tract exposure concentrations nationally is 1.4 $\mu\text{g}/\text{m}^3$, the average 90th percentile of within-

tract exposure concentration nationally is over 2 $\mu\text{g}/\text{m}^3$.

The potential population exposed to elevated concentrations near major roadways is large. A study of the populations nationally indicated that more than half of the population lives within 200 meters of a major road.¹² It should be noted that this analysis relied on the Census Bureau definition of a major road, which is not based on traffic volume. Thus, some of the roads designated as "major" may carry a low volume of traffic. This estimate is consistent with other studies that have examined the proximity of population to major roads. These studies are discussed in Section 3.5 of the RIA. In addition, analysis of data from the Census Bureau's American Housing Survey suggests that approximately 37 million people live within 300 feet (~100 meters) of a 4-or-more lane highway, railroad, or airport.¹³ American Housing Survey statistics, as well as epidemiology studies, indicate that those houses located near major transportation sources are more likely to be lower in income or have minority residents than houses not located near major transportation sources. These data are also discussed in detail in Section 3.5 of the RIA.

Other population studies also indicate that a significant fraction of the population resides in locations near major roads. At present, the available studies use different indicators of "major road" and of "proximity," but the estimates range from 12.4% of student enrollment in California attending schools within 150 meters of roads with 25,000 vehicles per day or more, to 13% of Massachusetts veterans living within 50 meters of a road with at least 10,000 vehicles per day.^{14, 15} Using a more general definition of a "major road," between 22% and 51% of different study populations live near such roads.

d. Exposure From Attached Garages

People living in homes with attached garages are potentially exposed to substantially higher overall

⁹ Acrolein was assigned an overall confidence level of "lower" based on consideration of the combined uncertainties from the modeling estimates. In contrast, formaldehyde was assigned an overall confidence level of "medium."

¹⁰ U.S. Environmental Protection Agency (2004) Air Quality Criteria for Particulate Matter. Research Triangle Park, NC: National Center for Environmental Assessment—RTP Office; Report No. EPA/600/P-99/002aF, p. 8–318.

¹¹ U.S. EPA. 2007. The HAPEM6 User's Guide. Prepared for Ted Palma, Office of Air Quality Planning and Standards, Research Triangle Park, NC, by Arlene Rosenbaum and Michael Huang, ICF International, January 2007. This document is available in Docket EPA-HQ-OAR-2005-0036. http://www.epa.gov/ttn/fera/human_hapem.html.

¹² Major roads are defined as those roads defined by the U.S. Census as one of the following: "limited access highway," "highway," "major road (primary, secondary and connecting roads)," or "ramp."

¹³ United States Census Bureau. (2004) American Housing Survey web page. [Online at <http://www.census.gov/hhes/www/housing/ahs/ahs03/ahs03.html>] Table IA-6.

¹⁴ Green, R.S.; Smorodinsky, S.; Kim, J.J.; McLaughlin, R.; Ostro, B. (2004) Proximity of California public schools to busy roads. *Environ. Health Perspect.* 112: 61–66.

¹⁵ Garshick, E.; Laden, F.; Hart, J.E.; Caron, A. (2003) Residence near a major road and respiratory symptoms in U.S. veterans. *Epidemiol.* 14: 728–736.

⁷ This includes emissions from mobile and stationary sources of these pollutants.

⁸ That is, the respiratory hazard index exceeded 1. See section III.B.3.a for more information.

concentrations of benzene, toluene, and other VOCs from mobile source-related emissions. EPA has conducted a modeling analysis to examine the influence of attached garages on personal exposure to benzene (see Appendix 3A of RIA). Compared to national average exposure concentrations modeled in 1999 NATA, which does not account for emissions originating in attached garages, average exposure concentrations for people with attached garages could more than double. Other recent studies also emphasize the substantial role of attached garages in exposure to MSATs. Chapter 3 of the RIA discusses measurements of concentrations and exposure associated with attached garages and EPA's modeling analysis.

3. What Are the Health Effects of Air Toxics?

a. Overview of Potential Cancer and Noncancer Health Effects

Air toxics can cause a variety of cancer and noncancer health effects. Inhalation cancer risks are usually estimated by EPA as "unit risks," which represent the excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 $\mu\text{g}/\text{m}^3$ in air. Some air toxics are known to be carcinogenic in animals but lack data in humans. Many of these have been assumed to be human carcinogens. Also, in the absence of evidence of a nonlinear dose-response curve, EPA assumes these relationships between exposure and probability of cancer are linear. These unit risks are typically upper bound estimates. Upper bound estimates are more likely to overestimate than underestimate risk. Where there are strong epidemiological data, a maximum likelihood estimate (MLE) may be developed. An MLE is a best scientific estimate of risk. The benzene unit risk is an MLE. A discussion of the confidence in a quantitative cancer risk estimate is provided in the IRIS file for each compound. The discussion of the confidence in the cancer risk estimate includes an assessment of the source of the data (human or animal), uncertainties in dose estimates, choice of the model used to fit the exposure and response data and how uncertainties and potential confounders are handled.

Potential noncancer chronic inhalation health risks are quantified using reference concentrations (RfCs) and noncancer chronic ingestion and dermal health risks are quantified using reference doses (RfDs). The RfC is an estimate (with uncertainty spanning

perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a lifetime. Sources of uncertainty in the development of the RfCs and RfDs include interspecies extrapolation (animal to human) and intraspecies extrapolation (average human to sensitive human). Additional sources of uncertainty can include the use of a lowest observed adverse effect level in place of a no observed adverse effect level, and other data deficiencies. A statement regarding the confidence in the RfC and/or RfD is developed to reflect the confidence in the principal study or studies on which the RfC or RfD are based and the confidence in the underlying database. Factors that affect the confidence in the principal study include how well the study was designed, conducted and reported. Factors that affect the confidence in the database include an assessment of the availability of information regarding identification of the critical effect, potentially susceptible populations and exposure scenarios relevant to assessment of risk.

The RfC may be used to estimate a hazard quotient, which is the environmental exposure to a substance divided by its RfC. A hazard quotient greater than one indicates adverse health effects are possible. The hazard quotient cannot be translated to a probability that adverse health effects will occur, and is unlikely to be proportional to risk. It is especially important to note that a hazard quotient exceeding one does not necessarily mean that adverse health effects will occur. In NATA, hazard quotients for different respiratory irritants were also combined into a hazard index (HI). A hazard index is the sum of hazard quotients for substances that affect the same target organ or organ system. Because different pollutants may cause similar adverse health effects, it is often appropriate to combine hazard quotients associated with different substances. However, the HI is only an approximation of a combined effect because substances may affect a target organ in different ways.

b. Health Effects of Key MSATs

i. Benzene

The EPA's IRIS database lists benzene, an aromatic hydrocarbon, as a known human carcinogen (causing leukemia) by all routes of exposure.¹⁶ A

¹⁶ U.S. EPA (2000). Integrated Risk Information System File for Benzene. This material is available

electronically at <http://www.epa.gov/iris/subst/0276.htm>.

number of adverse noncancer health effects including blood disorders and immunotoxicity have also been associated with long-term occupational exposure to benzene.¹⁷

Inhalation is the major source of human exposure to benzene in occupational and non-occupational settings. Long-term occupational inhalation exposure to benzene has been shown to cause cancers of the hematopoietic (blood cell) system in adults.¹⁸ Among these are acute nonlymphocytic leukemia¹⁹ and chronic lymphocytic leukemia.^{20, 21} Leukemias, lymphomas, and other tumor types have been observed in experimental animals exposed to benzene by inhalation or oral administration. Exposure to benzene and/or its metabolites has also been linked with chromosomal changes in

electronically at <http://www.epa.gov/iris/subst/0276.htm>.

¹⁷ U.S. EPA (2002). Toxicological Review of Benzene (Noncancer Effects). National Center for Environmental Assessment, Washington, DC. Report No. EPA/635/R-02/001F. <http://www.epa.gov/iris/toxreviews/0276-tr.pdf>.

¹⁸ U.S. EPA (1998) Carcinogenic Effects of Benzene: An Update, National Center for Environmental Assessment, Washington, DC. EPA600-P-97-001F. Enter report number at the following search page, <http://yosemite.epa.gov/ncepihom/nsCatalog.nsf/SearchPubs?Openform>.

¹⁹ Leukemia is a blood disease in which the white blood cells are abnormal in type or number. Leukemia may be divided into nonlymphocytic (granulocytic) leukemias and lymphocytic leukemias. Nonlymphocytic leukemia generally involves the types of white blood cells (leukocytes) that are involved in engulfing, killing, and digesting bacteria and other parasites (phagocytosis) as well as releasing chemicals involved in allergic and immune responses. This type of leukemia may also involve erythroblastic cell types (immature red blood cells). Lymphocytic leukemia involves the lymphocyte type of white blood cell that is responsible for antibody and cell-mediated immune responses. Both nonlymphocytic and lymphocytic leukemia may, in turn, be separated into acute (rapid and fatal) and chronic (lingering, lasting) forms. For example in acute myeloid leukemia there is diminished production of normal red blood cells (erythrocytes), granulocytes, and platelets (control clotting), which leads to death by anemia, infection, or hemorrhage. These events can be rapid. In chronic myeloid leukemia (CML) the leukemic cells retain the ability to differentiate (*i.e.*, be responsive to stimulatory factors) and perform function; later there is a loss of the ability to respond.

²⁰ U.S. EPA (1985) Environmental Protection Agency, Interim quantitative cancer unit risk estimates due to inhalation of benzene, prepared by the Office of Health and Environmental Assessment, Carcinogen Assessment Group, Washington, DC for the Office of Air Quality Planning and Standards, Washington, DC, 1985.

²¹ U.S. EPA (1993) Motor Vehicle-Related Air Toxics Study. Office of Mobile Sources, Ann Arbor, MI. http://www.epa.gov/otaq/regs/toxics/tox_archive.htm.

humans and animals^{22, 23} and increased proliferation of mouse bone marrow cells.^{24, 25}

The latest assessment by EPA estimates the excess risk of developing leukemia from inhalation exposure to benzene at 2.2×10^{-6} to 7.8×10^{-6} per $\mu\text{g}/\text{m}^3$. In other words, there is an estimated risk of about two to eight excess leukemia cases in one million people exposed to $1 \mu\text{g}/\text{m}^3$ of benzene over a lifetime.²⁶ This range of unit risks reflects the MLEs calculated from different exposure assumptions and dose-response models that are linear at low doses. At present, the true cancer risk from exposure to benzene cannot be ascertained, even though dose-response data are used in the quantitative cancer risk analysis, because of uncertainties in the low-dose exposure scenarios and lack of clear understanding of the mode of action. A range of estimates of risk is recommended, each having equal scientific plausibility. There are confidence intervals associated with the MLE range that reflect variation of the observed data used to develop dose-response values. For the upper end of the MLE range, the 5th and 95th percentile values are about a factor of 5 lower and higher than the best fit value. The upper end of the MLE range was used in NATA.

It should be noted that not enough information is known to determine the slope of the dose-response curve at

environmental levels of exposure and to provide a sound scientific basis to choose any particular extrapolation/exposure model to estimate human cancer risk at low doses. EPA risk assessment guidelines suggest using an assumption of linearity of dose response when (1) there is an absence of sufficient information on modes of action or (2) the mode of action information indicates that the dose-response curve at low dose is or is expected to be linear.²⁷ Since the mode of action for benzene carcinogenicity is unknown, the current cancer unit risk estimate assumes linearity of the low-dose response. Data that were considered by EPA in its carcinogenic update suggested that the dose-response relationship at doses below those examined in the studies reviewed in EPA's most recent benzene assessment may be supralinear. Such a relationship could support the inference that cancer risks are as high or are higher than the estimates provided in the existing EPA assessment.²⁸ Data discussed in the EPA IRIS assessment suggest that genetic abnormalities occur at low exposure in humans, and the formation of toxic metabolites plateaus above 25 ppm ($80,000 \mu\text{g}/\text{m}^3$).²⁹ More recent data on benzene adducts in humans, published after the most recent IRIS assessment, suggest that the enzymes involved in benzene metabolism start to saturate at exposure levels as low as 1 ppm.^{30, 31, 32} These data highlight the importance of ambient exposure levels and their contribution to benzene-related adducts. Because there is a transition from linear to saturable metabolism below 1 ppm, the assumption of low-dose linearity extrapolated from much higher exposures could lead to substantial

underestimation of leukemia risks. This is consistent with recent epidemiological data which also suggest a supralinear exposure-response relationship and which "[extend] evidence for hematopoietic cancer risks to levels substantially lower than had previously been established."^{33, 34, 35} These data are from the largest cohort studies done to date with individual worker exposure estimates. However, these data have not yet been formally evaluated by EPA as part of the IRIS review process, and it is not clear how they might influence low-dose risk estimates. A better understanding of the biological mechanism of benzene-induced leukemia is needed.

Children may represent a subpopulation at increased risk from benzene exposure, due to factors that could increase their susceptibility. Children may have a higher unit body weight exposure because of their heightened activity patterns which can increase their exposures, as well as different ventilation tidal volumes and frequencies, factors that influence uptake. This could entail a greater lifetime risk of leukemia and other toxic effects from exposures occurring during childhood, if children are exposed to benzene at similar levels as adults. There is limited information from two studies regarding an increased risk to children whose parents have been occupationally exposed to benzene.^{36, 37} Data from animal studies have shown benzene exposures result in damage to the hematopoietic (blood cell formation) system during development.^{38, 39, 40}

²² International Agency for Research on Cancer (IARC) (1982) IARC monographs on the evaluation of carcinogenic risk of chemicals to humans, Volume 29, Some industrial chemicals and dyestuffs, International Agency for Research on Cancer, World Health Organization, Lyon, France, p. 345–389.

²³ U.S. EPA (1998) Carcinogenic Effects of Benzene: An Update, National Center for Environmental Assessment, Washington, DC. EPA600-P-97-001F. Enter report number at the following search page, <http://yosemite.epa.gov/ncepihom/nsCatalog.nsf/SearchPubs?Openform>.

²⁴ Irons, R.D., W.S. Stillman, D.B. Colagiovanni, and V.A. Henry (1992) Synergistic action of the benzene metabolite hydroquinone on myelopoietic stimulating activity of granulocyte/macrophage colony-stimulating factor in vitro, Proc. Natl. Acad. Sci. 89:3691–3695.

²⁵ U.S. EPA (1998) Carcinogenic Effects of Benzene: An Update, National Center for Environmental Assessment, Washington, DC. EPA600-P-97-001F. Enter report number at the following search page, <http://yosemite.epa.gov/ncepihom/nsCatalog.nsf/SearchPubs?Openform>.

²⁶ U.S. EPA (1998) Carcinogenic Effects of Benzene: An Update, National Center for Environmental Assessment, Washington, DC. EPA600-P-97-001F. Enter report number at the following search page, <http://yosemite.epa.gov/ncepihom/nsCatalog.nsf/SearchPubs?Openform>.

²⁷ U.S. EPA (2005) Guidelines for Carcinogen Risk Assessment. Report No. EPA/630/P-03/001F. <http://cfpub.epa.gov/ncea/raf/recordisplay.cfm?deid=116283>.

²⁸ U.S. EPA (1998) Carcinogenic Effects of

²⁷ U.S. EPA (2005) Guidelines for Carcinogen Risk Assessment. Report No. EPA/630/P-03/001F. <http://cfpub.epa.gov/ncea/raf/recordisplay.cfm?deid=116283>.

²⁸ U.S. EPA (1998) Carcinogenic Effects of Benzene: An Update. EPA/600/P-97/001F.

²⁹ Rothman, N.; Li, G.L.; Dosemeci, M.; et al. (1996) Hematotoxicity among Chinese workers heavily exposed to benzene. Am. J. Indust. Med. 29:236–246.

³⁰ Rappaport, S.M.; Waidyanatha, S.; Qu, Q.; Shore, R.; Jin, X.; Cohen, B.; Chen, L.; Melikian, A.; Li, G.; Yin, S.; Yan, H.; Xu, B.; Mu, R.; Li, Y.; Zhang, X.; and Li, K. (2002) Albumin adducts of benzene oxide and 1,4-benzoquinone as measures of human benzene metabolism. Cancer Research 62:1330–1337.

³¹ Rappaport, S.M.; Waidyanatha, S.; Qu, Q.; Yeowell-O'Connell, K.; Rothman, N.; Smith M.T.; Zhang, L.; Qu, Q.; Shore, R.; Li, G.; Yin, S. (2005) Protein adducts as biomarkers of human enzyme metabolism. Chem Biol Interact. 153–154:103–109.

³² Lin, Y.-S., Vermeulen, R., Tsai, C.H., Suramya, W., Lan, Q., Rothman, N., Smith, M.T., Zhang, L., Shen, M., Songnian, Y., Kim, S., Rappaport, S.M. (2006) Albumin adducts of electrophilic benzene metabolites in benzene-exposed and control workers. Environ Health Perspec.

³³ Hayes, R.B.; Yin, S.; Dosemeci, M.; Li, G.; Wacholder, S.; Travis, L.B.; Li, C.; Rothman, N.; Hoover, R.N.; and Linet, M.S. (1997) Benzene and the dose-related incidence of hematologic neoplasms in China. J. Nat. Cancer Inst. 89:1065–1071.

³⁴ Hayes, R.B.; Songnian, Y.; Dosemeci, M.; and Linet, M. (2001) Benzene and lymphohematopoietic malignancies in humans. Am. J. Indust. Med. 40:117–126.

³⁵ Lan, Q.; Zhang, L.; Li, G.; Vermeulen, R., et al. (2004). Hematotoxicity in Workers Exposed to Low Levels of Benzene. Science 306: 1774–1776.

³⁶ Shu, X.O.; Gao, Y.T.; Brinton, L.A.; et al. (1988) A population-based case-control study of childhood leukemia in Shanghai. Cancer 62:635–644.

³⁷ McKinney P.A.; Alexander, F.E.; Cartwright, R.A.; et al. (1991) Parental occupations of children with leukemia in west Cumbria, north Humberdale, and Gateshead, Br. Med. J. 302:681–686.

³⁸ Keller, K.A.; Snyder, C.A. (1986) Mice exposed in utero to low concentrations of benzene exhibit enduring changes in their colony forming hematopoietic cells. Toxicology 42:171–181.

³⁹ Keller, K.A.; Snyder, C.A. (1988) Mice exposed in utero to 20 ppm benzene exhibit altered numbers of recognizable hematopoietic cells up to seven weeks after exposure. Fundam. Appl. Toxicol. 10:224–232.

⁴⁰ Corti, M.; Snyder, C.A. (1996) Influences of gender, development, pregnancy and ethanol consumption on the hematotoxicity of inhaled 10 ppm benzene. Arch. Toxicol. 70:209–217.

Also, key changes related to the development of childhood leukemia occur in the developing fetus.⁴¹ Several studies have reported that genetic changes related to eventual leukemia development occur before birth. For example, there is one study of genetic changes in twins who developed T cell leukemia at 9 years of age.⁴² An association between traffic volume, residential proximity to busy roads and occurrence of childhood leukemia has also been identified in some studies, although some studies show no association.

A number of adverse noncancer health effects, including blood disorders such as preleukemia and aplastic anemia, have also been associated with long-term exposure to benzene.^{43, 44} People with long-term occupational exposure to benzene have experienced harmful effects on the blood-forming tissues, especially in the bone marrow. These effects can disrupt normal blood production and suppress the production of important blood components, such as red and white blood cells and blood platelets, leading to anemia (a reduction in the number of red blood cells), leukopenia (a reduction in the number of white blood cells), or thrombocytopenia (a reduction in the number of blood platelets, thus reducing the ability of blood to clot). Chronic inhalation exposure to benzene in humans and animals results in pancytopenia,⁴⁵ a condition characterized by decreased numbers of circulating erythrocytes (red blood cells), leukocytes (white blood cells),

and thrombocytes (blood platelets).^{46, 47} Individuals that develop pancytopenia and have continued exposure to benzene may develop aplastic anemia, whereas others exhibit both pancytopenia and bone marrow hyperplasia (excessive cell formation), a condition that may indicate a preleukemic state.^{48, 49} The most sensitive noncancer effect observed in humans, based on current data, is the depression of the absolute lymphocyte count in blood.^{50, 51}

EPA's inhalation reference concentration (RfC) for benzene is 30 $\mu\text{g}/\text{m}^3$, based on suppressed absolute lymphocyte counts as seen in humans under occupational exposure conditions. The overall confidence in this RfC is medium. Since development in this RfC, human reports of benzene's hematotoxic effects have been published in the literature that provides data suggesting a wide range of hematological endpoints that are affected at occupational exposures of less than 5 ppm (about 16 mg/m^3)⁵² and at air levels of 1 ppm (about 3 mg/m^3) or less among genetically susceptible populations.⁵³ One recent study found benzene metabolites in mouse liver and bone marrow at environmental doses, indicating that even concentrations in urban air can elicit a biochemical response in rodents that indicates toxicity.⁵⁴ EPA has not formally

evaluated these recent studies as part of the IRIS review process to determine whether or not they will lead to a change in the current RfC. EPA does not currently have an acute reference concentration for benzene. The Agency for Toxic Substances and Disease Registry Minimal Risk Level for acute exposure to benzene is 160 $\mu\text{g}/\text{m}^3$ for 1–14 days exposure.

ii. 1,3-Butadiene

EPA has characterized 1,3-butadiene, a hydrocarbon, as a leukemogen, carcinogenic to humans by inhalation.^{55 56} The specific mechanisms of 1,3-butadiene-induced carcinogenesis are unknown; however, it is virtually certain that the carcinogenic effects are mediated by genotoxic metabolites of 1,3-butadiene. Animal data suggest that females may be more sensitive than males for cancer effects; nevertheless, there are insufficient data in humans from which to draw any conclusions on potentially sensitive subpopulations. The upper bound cancer unit risk estimate is 0.08 per ppm or 3×10^{-5} per $\mu\text{g}/\text{m}^3$ (based primarily on linear modeling and extrapolation of human data). In other words, it is estimated that approximately 30 persons in one million exposed to 1 $\mu\text{g}/\text{m}^3$ of 1,3-butadiene continuously for their lifetime would develop cancer as a result of this exposure. The human incremental lifetime unit cancer risk estimate is based on extrapolation from leukemias observed in an occupational epidemiologic study.^{57 58} This estimate includes a two-fold adjustment to the epidemiologic-based unit cancer risk applied to reflect evidence from the rodent bioassays suggesting that the epidemiologic-based estimate (from males) may underestimate total cancer

exposure from Urban Air. Res Rep Health Effect Inst 113.

⁵⁵ U.S. EPA. (2002). Health Assessment of 1,3-Butadiene. Office of Research and Development, National Center for Environmental Assessment, Washington Office, Washington, DC. Report No. EPA600-P-98-001F. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=54499>.

⁵⁶ EPA 2005 "Full IRIS Summary for 1,3-butadiene (CASRN 106-99-0)" Environmental Protection Agency, Integrated Risk Information System (IRIS), Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, <http://www.epa.gov/iris/subst/0139.htm>.

⁵⁷ Delzell, E. N. Sathiakumar, M. Macaluso, et al. (1995). A follow-up study of synthetic rubber workers. Submitted to the International Institute of Synthetic Rubber Producers. University of Alabama at Birmingham. October 2, 1995.

⁵⁸ EPA 2005 "Full IRIS Summary for 1,3-butadiene (CASRN 106-99-0)" Environmental Protection Agency, Integrated Risk Information System (IRIS), Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, <http://www.epa.gov/iris/subst/0139.htm>.

⁴¹ U.S. EPA. (2002). Toxicological Review of Benzene (Noncancer Effects). National Center for Environmental Assessment, Washington, DC. Report No. EPA/635/R-02/001F. <http://www.epa.gov/iris/toxreviews/0276-tr.pdf>.

⁴² Ford, AM; Pombo-de-Oliveira, MS; McCarthy, KP; MacLean, JM; Carrico, KC; Vincent, RF; Greaves, M. (1997) Monoclonal origin of concordant T-cell malignancy in identical twins. *Blood* 89:281–285.

⁴³ Aksoy, M. (1989) Hematotoxicity and carcinogenicity of benzene. *Environ. Health Perspect.* 82:193–197.

⁴⁴ Goldstein, B.D. (1988) Benzene toxicity. *Occupational medicine. State of the Art Reviews* 3: 541–554.

⁴⁵ Pancytopenia is the reduction in the number of all three major types of blood cells (erythrocytes, or red blood cells, thrombocytes, or platelets, and leukocytes, or white blood cells). In adults, all three major types of blood cells are produced in the bone marrow of the skeletal system. The bone marrow contains immature cells, known as multipotent myeloid stem cells, that later differentiate into the various mature blood cells. Pancytopenia results from a reduction in the ability of the red bone marrow to produce adequate numbers of these mature blood cells.

⁴⁶ Aksoy, M. (1991) Hematotoxicity, leukemogenicity and carcinogenicity of chronic exposure to benzene. In: Arinc, E.; Schenkman, J.B.; Hodgson, E., Eds. *Molecular Aspects of Monooxygenases and Bioactivation of Toxic Compounds*. New York: Plenum Press, pp. 415–434.

⁴⁷ Goldstein, B.D. (1988) Benzene toxicity. *Occupational medicine. State of the Art Reviews* 3: 541–554.

⁴⁸ Aksoy, M., S. Erdem, and G. Dincol. (1974) Leukemia in shoe-workers exposed chronically to benzene. *Blood* 44:837.

⁴⁹ Aksoy, M. and K. Erdem. (1978) A follow-up study on the mortality and the development of leukemia in 44 pancytopenic patients associated with long-term exposure to benzene. *Blood* 52: 285–292.

⁵⁰ Rothman, N., G.L. Li, M. Dosemeci, W.E. Bechtold, G.E. Marti, Y.Z. Wang, M. Linet, L.Q. Xi, W. Lu, M.T. Smith, N. Titenko-Holland, L.P. Zhang, W. Blot, S.N. Yin, and R.B. Hayes (1996) Hematotoxicity among Chinese workers heavily exposed to benzene. *Am. J. Ind. Med.* 29: 236–246.

⁵¹ EPA 2005 "Full IRIS Summary for Benzene (CASRN 71-43-2)" Environmental Protection Agency, Integrated Risk Information System (IRIS), Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, <http://www.epa.gov/iris/subst/0276.htm>.

⁵² Qu, Q., R. Shore, G. Li, X. Jin, L.C. Chen, B. Cohen, et al. (2002). Hematological changes among Chinese workers with a broad range of benzene exposures. *Am. J. Industr. Med.* 42: 275–285.

⁵³ Lan, Q.; Zhang, L., Li, G., Vermeulen, R., et al. (2004). Hematotoxicity in Workers Exposed to Low Levels of Benzene. *Science* 306: 1774–1776.

⁵⁴ Turteltaub, K.W. and Mani, C. (2003). Benzene metabolism in rodents at doses relevant to human

risk from 1,3-butadiene exposure in the general population, particularly for breast cancer in females. A recent study extended the investigation of 1,3-butadiene exposure and leukemia among synthetic rubber industry workers.⁵⁹ The results of this study strengthen the evidence for the relationship between 1,3-butadiene exposure and lymphohematopoietic cancer. This relationship was found to persist after controlling for exposure to other toxics in this work environment.

1,3-Butadiene also causes a variety of reproductive and developmental effects in mice; no human data on these effects are available. The most sensitive effect was ovarian atrophy observed in a lifetime bioassay of female mice.⁶⁰ Based on this critical effect and the benchmark concentration methodology, an RfC was calculated. This RfC for chronic health effects is 0.9 ppb, or about 2 µg/m³. Confidence in the inhalation RfC is medium.

iii. Formaldehyde

Since 1987, EPA has classified formaldehyde, a hydrocarbon, as a probable human carcinogen based on evidence in humans and in rats, mice, hamsters, and monkeys.⁶¹ EPA's current IRIS summary provides an upper bound cancer unit risk estimate of 1.3×10^{-5} per µg/m³.⁶² In other words, there is an estimated risk of about thirteen excess leukemia cases in one million people exposed to 1 µg/m³ of formaldehyde over a lifetime.

EPA is currently reviewing recently published epidemiological data. For instance, research conducted by the National Cancer Institute (NCI) found an increased risk of nasopharyngeal cancer and lymphohematopoietic malignancies such as leukemia among workers exposed to formaldehyde.^{63 64} NCI is

currently performing an update of these studies. A recent National Institute of Occupational Safety and Health (NIOSH) study of garment workers also found increased risk of death due to leukemia among workers exposed to formaldehyde.⁶⁵ Extended follow-up of a cohort of British chemical workers did not find evidence of an increase in nasopharyngeal or lymphohematopoietic cancers, but a continuing statistically significant excess in lung cancers was reported.⁶⁶

Based on the developments of the last decade, in 2004, the working group of the International Agency for Research on Cancer concluded that formaldehyde is carcinogenic to humans (Group 1 classification) on the basis of sufficient evidence in humans and sufficient evidence in experimental animals—a higher classification than previous IARC evaluations. In addition, the National Institute of Environmental Health Sciences recently nominated formaldehyde for reconsideration as a known human carcinogen under the National Toxicology Program. Since 1981 it has been listed as a “reasonably anticipated human carcinogen.” Recently the German Federal Institute for Risk Assessment determined that formaldehyde is a known human carcinogen.⁶⁷

In the past 15 years there has been substantial research on the inhalation dosimetry for formaldehyde in rodents and primates by the CIIT Centers for Health Research, with a focus on use of rodent data for refinement of the quantitative cancer dose-response assessment.^{68 69 70} CIIT's risk assessment of formaldehyde incorporated mechanistic and dosimetric information

on formaldehyde. The risk assessment analyzed carcinogenic risk from inhaled formaldehyde using approaches that were consistent with EPA's draft guidelines for carcinogenic risk assessment. In 2001, Environment Canada relied on this cancer dose-response assessment in their assessment of formaldehyde.⁷¹ In 2004, EPA also relied on this cancer unit risk estimate during the development of the plywood and composite wood products national emissions standards for hazardous air pollutants (NESHAPs).⁷² In these rules, EPA concluded that the CIIT work represented the best available application of the available mechanistic and dosimetric science on the dose-response for portal of entry cancers due to formaldehyde exposures. EPA is reviewing the recent work cited above from the NCI and NIOSH, as well as the analysis by the CIIT Centers for Health Research and other studies, as part of a reassessment of the human hazard and dose-response associated with formaldehyde.

Noncancer effects of formaldehyde have been observed in humans and several animal species and include irritation to eye, nose and throat tissues in conjunction with increased mucous secretions.

iv. Acetaldehyde

Acetaldehyde, a hydrocarbon, is classified in EPA's IRIS database as a probable human carcinogen and is considered toxic by inhalation.⁷³ Based on nasal tumors in rodents, the upper confidence limit estimate of a lifetime extra cancer risk from continuous acetaldehyde exposure is about 2.2×10^{-6} per µg/m³. In other words, it is estimated that about 2 persons in one million exposed to 1 µg/m³ acetaldehyde continuously for their lifetime (70 years) would develop cancer as a result of their exposure, although the risk could be as low as zero. In short-term (4 week) rat studies, compound-related histopathological changes were observed only in the respiratory system at various concentration levels of exposure.^{74 75}

⁵⁹ Delzell, E., Sathiakumar, N., Graff, J., Macaluso, M., Maldonado, G., Matthews, R. (2006) An updated study of mortality among North American synthetic rubber industry workers. Health Effects Institute Report Number 132.

⁶⁰ Bevan, C.; Stadler, J.C.; Elliot, G.S.; et al. (1996) Subchronic toxicity of 4-vinylcyclohexene in rats and mice by inhalation. *Fundam. Appl. Toxicol.* 32:1–10.

⁶¹ U.S. EPA (1987). Assessment of Health Risks to Garment Workers and Certain Home Residents From Exposure to Formaldehyde, Office of Pesticides and Toxic Substances, April 1987.

⁶² U.S. EPA (1989). Integrated Risk Information System File for Formaldehyde. This material is available electronically at <http://www.epa.gov/iris/substi/0419.htm>.

⁶³ Hauptmann, M.; Lubin, J. H.; Stewart, P. A.; Hayes, R. B.; Blair, A. 2003. Mortality from lymphohematopoietic malignancies among workers in formaldehyde industries. *Journal of the National Cancer Institute* 95: 1615–1623.

⁶⁴ Hauptmann, M.; Lubin, J. H.; Stewart, P. A.; Hayes, R. B.; Blair, A. 2004. Mortality from solid cancers among workers in formaldehyde industries. *American Journal of Epidemiology* 159: 1117–1130.

⁶⁵ Pinkerton, L. E. 2004. Mortality among a cohort of garment workers exposed to formaldehyde: an update. *Occup. Environ. Med.* 61: 193–200.

⁶⁶ Coggon, D, EC Harris, J Poole, KT Palmer. 2003. Extended follow-up of a cohort of British chemical workers exposed to formaldehyde. *J National Cancer Inst.* 95:1608–1615.

⁶⁷ Bundesinstitut für Risikobewertung (BfR) Toxicological Assessment of Formaldehyde. Opinion of BfR No. 023/2006 of 30 March 2006. www.bfr.bund.de/cm/290/toxicological_assessment_of_formaldehyde.pdf.

⁶⁸ Conolly, RB, JS Kimbell, D Janszen, PM Schlosser, D Kalisak, J Preston, and FJ Miller. 2003. Biologically motivated computational modeling of formaldehyde carcinogenicity in the F344 rat. *Tox. Sci.* 75: 432–447.

⁶⁹ Conolly, RB, JS Kimbell, D Janszen, PM Schlosser, D Kalisak, J Preston, and FJ Miller. 2004. Human respiratory tract cancer risks of inhaled formaldehyde: Dose-response predictions derived from biologically-motivated computational modeling of a combined rodent and human dataset. *Tox. Sci.* 82: 279–296.

⁷⁰ Chemical Industry Institute of Toxicology (CIIT). 1999. Formaldehyde: Hazard characterization and dose-response assessment for carcinogenicity by the route of inhalation. CIIT, September 28, 1999. Research Triangle Park, NC.

⁷¹ Health Canada. 2001. Priority Substances List Assessment Report. Formaldehyde. Environment Canada, Health Canada, February 2001.

⁷² U.S. EPA. 2004. National Emission Standards for Hazardous Air Pollutants for Plywood and Composite Wood Products Manufacture: Final Rule. (69 FR 45943, 7/30/04).

⁷³ U.S. EPA. 1988. Integrated Risk Information System File of Acetaldehyde. This material is available electronically at <http://www.epa.gov/iris/substi/0290.htm>.

⁷⁴ Appleman, L. M., R. A. Woutersen, V. J. Feron, R. N. Hooffman, and W. R. F. Notten. (1986). Effects of the variable versus fixed exposure levels on the toxicity of acetaldehyde in rats. *J. Appl. Toxicol.* 6: 331–336.

Data from these studies showing degeneration of the olfactory epithelium were found to be sufficient for EPA to develop an RfC for acetaldehyde of $9 \mu\text{g}/\text{m}^3$. Confidence in the principal study is medium and confidence in the database is low, due to the lack of chronic data establishing a no observed adverse effect level and due to the lack of reproductive and developmental toxicity data. Therefore, there is low confidence in the RfC. The agency is currently conducting a reassessment of risk from inhalation exposure to acetaldehyde.

The primary acute effect of exposure to acetaldehyde vapors is irritation of the eyes, skin, and respiratory tract.⁷⁶ Some asthmatics have been shown to be a sensitive subpopulation to decrements in functional expiratory volume (FEV1 test) and bronchoconstriction upon acetaldehyde inhalation.⁷⁷

v. Acrolein

Acrolein, a hydrocarbon, is intensely irritating to humans when inhaled, with acute exposure resulting in upper respiratory tract irritation and congestion. The Agency has developed an RfC for acrolein of $0.02 \mu\text{g}/\text{m}^3$.⁷⁸ The overall confidence in the RfC assessment is judged to be medium. The Agency is also currently in the process of conducting an assessment of acute health effects for acrolein. EPA determined in 2003 using the 1999 draft cancer guidelines that the human carcinogenic potential of acrolein could not be determined because the available data were inadequate. No information was available on the carcinogenic effects of acrolein in humans and the animal data provided inadequate evidence of carcinogenicity.

vi. Polycyclic Organic Matter (POM)

POM is generally defined as a large class of organic compounds which have multiple benzene rings and a boiling point greater than 100 degrees Celsius. Many of the compounds included in the

class of compounds known as POM are classified by EPA as probable human carcinogens based on animal data. One of these compounds, naphthalene, is discussed separately below.

Polycyclic aromatic hydrocarbons (PAHs) are a chemical subset of POM. In particular, EPA frequently obtains data on 16 of these POM compounds. Recent studies have found that maternal exposures to PAHs in a population of pregnant women were associated with several adverse birth outcomes, including low birth weight and reduced length at birth, as well as impaired cognitive development at age three.^{79, 80} These studies are discussed in the Regulatory Impact Analysis.

vii. Naphthalene

Naphthalene is a PAH compound consisting of two benzene rings fused together with two adjacent carbon atoms common to both rings. In 2004, EPA released an external review draft of a reassessment of the inhalation carcinogenicity of naphthalene.⁸¹ The draft reassessment, External Review Draft, IRIS Reassessment of the Inhalation Carcinogenicity of Naphthalene, U.S. EPA, completed external peer review in 2004 by Oak Ridge Institute for Science and Education.⁸² Based on external comments, additional analyses are being considered. California EPA has released a new risk assessment for naphthalene with a cancer unit risk estimate of 3×10^{-5} per $\mu\text{g}/\text{m}^3$.⁸³ The California EPA value was used in the 1999 NATA and in the analyses done for this rule. In addition, IARC has reevaluated naphthalene and re-classified it as Group 2B: possibly carcinogenic to

humans.⁸⁴ Current risk estimates for naphthalene are based on extrapolations from rodent studies conducted at higher doses. At present, human data are inadequate for developing estimates.

The current EPA IRIS assessment includes noncancer data on hyperplasia and metaplasia in nasal tissue that form the basis of an inhalation RfC of $3 \mu\text{g}/\text{m}^3$.⁸⁵ The principal study was given medium confidence because adequate numbers of animals were used, and the severity of nasal effects increased at the higher exposure concentration. However, the study produced high mortality and hematological evaluation was not conducted beyond 14 days. The database was given a low-to-medium confidence rating because there are no chronic or subchronic inhalation studies in other animal species, and there are no reproductive or developmental studies for inhalation exposure. In the absence of human or primate toxicity data, the assumption is made that nasal responses in mice to inhaled naphthalene are relevant to humans; however, it cannot be said with certainty that this RfC for naphthalene based on nasal effects will be protective for hemolytic anemia and cataracts, the more well-known human effects from naphthalene exposure. As a result, we have medium confidence in the RfC.

viii. Diesel Exhaust

In EPA's Diesel Health Assessment Document (HAD),⁸⁶ diesel exhaust was classified as likely to be carcinogenic to humans by inhalation at environmental exposures, in accordance with the revised draft 1996/1999 EPA cancer guidelines. A number of other agencies (National Institute for Occupational Safety and Health, the International Agency for Research on Cancer, the World Health Organization, California EPA, and the U.S. Department of Health and Human Services) have made similar classifications. EPA concluded in the Diesel HAD that it is not possible currently to calculate a cancer unit risk for diesel exhaust due to a variety of factors that limit the current studies,

⁷⁵ Appleman, L.M., R.A. Woutersen, and V.J. Feron. (1982). Inhalation toxicity of acetaldehyde in rats. I. Acute and subacute studies. *Toxicology*. 23: 293–297.

⁷⁶ U.S. EPA (1988). Integrated Risk Information System File of Acetaldehyde. This material is available electronically at <http://www.epa.gov/iris/subst/0290.htm>.

⁷⁷ Myou, S.; Fujimura, M.; Nishi K.; Ohka, T.; and Matsuda, T. (1993) Aerosolized acetaldehyde induces histamine-mediated bronchoconstriction in asthmatics. *Am. Rev. Respir. Dis.* 148(4 Pt 1): 940–3.

⁷⁸ U.S. Environmental Protection Agency (2003) Integrated Risk Information System (IRIS) on Acrolein. National Center for Environmental Assessment, Office of Research and Development, Washington, D.C. 2003. This material is available electronically at <http://www.epa.gov/iris/subst/0364.htm>.

⁷⁹ Perera, F.P.; Rauh, V.; Tsai, W.-Y.; *et al.* (2002) Effect of transplacental exposure to environmental pollutants on birth outcomes in a multiethnic population. *Environ Health Perspect.* 111: 201–205.

⁸⁰ Perera, F.P.; Rauh, V.; Whyatt, R.M.; Tsai, W.Y.; Tang, D.; Diaz, D.; Hoepner, L.; Barr, D.; Tu, Y.H.; Camann, D.; Kinney, P. (2006) Effect of prenatal exposure to airborne polycyclic aromatic hydrocarbons on neurodevelopment in the first 3 years of life among inner-city children. *Environ Health Perspect* 114: 1287–1292.

⁸¹ U.S. EPA (1998) Integrated Risk Information System (IRIS) summary on Naphthalene. National Center for Environmental Assessment, Office of Research and Development, Washington, D.C. 2003. This material is available electronically at <http://www.epa.gov/iris/subst/0436.htm>.

⁸² Oak Ridge Institute for Science and Education. (2004) External Peer Review for the IRIS Reassessment of the Inhalation Carcinogenicity of Naphthalene. August 2004. <http://cfpub2.epa.gov/ncea/cfm/recordisplay.cfm?deid=86019>.

⁸³ California EPA. (2004) Long Term Health Effects of Exposure to Naphthalene. Office of Environmental Health Hazard Assessment. http://www.oehha.ca.gov/air/toxic_contaminants/draftnaphth.html.

⁸⁴ International Agency for Research on Cancer (IARC). (2002) Monographs on the Evaluation of the Carcinogenic Risk of Chemicals for Humans. Vol. 82. Lyon, France.

⁸⁵ EPA 2005 "Full IRIS Summary for Naphthalene (CASRN 91–20–3)" Environmental Protection Agency, Integrated Risk Information System (IRIS), Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH <http://www.epa.gov/iris/subst/0436.htm>.

⁸⁶ U.S. EPA (2002) Health Assessment Document for Diesel Engine Exhaust. EPA/600/8–90/057F Office of Research and Development, Washington, DC. This document is available electronically at <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=29060>.

such as limited quantitative exposure histories in occupational groups investigated for lung cancer.

However, in the absence of a cancer unit risk, the EPA Diesel HAD sought to provide additional insight into the significance of the cancer hazard by estimating possible ranges of risk that might be present in the population. An exploratory analysis was used to characterize a possible risk range by comparing a typical environmental exposure level for highway diesel sources to a selected range of occupational exposure levels. The occupationally observed risks were then proportionally scaled according to the exposure ratios to obtain an estimate of the possible environmental risk. A number of calculations are needed to accomplish this, and these can be seen in the EPA Diesel HAD. The outcome was that environmental risks from diesel exhaust exposure could range from a low of 10^{-4} to 10^{-5} to as high as 10^{-3} , reflecting the range of occupational exposures that could be associated with the relative and absolute risk levels observed in the occupational studies. Because of uncertainties, the analysis acknowledged that the risks could be lower than 10^{-4} or 10^{-5} , and a zero risk from diesel exhaust exposure was not ruled out.

Noncancer health effects of acute and chronic exposure to diesel exhaust emissions are also of concern to the Agency. EPA derived an RfC from consideration of four well-conducted chronic rat inhalation studies showing adverse pulmonary effects.^{87 88 89 90} The RfC is $5 \mu\text{g}/\text{m}^3$ for diesel exhaust as measured by diesel PM. This RfC does not consider allergenic effects such as those associated with asthma or immunologic effects. There is growing evidence, discussed in the Diesel HAD, that diesel exhaust can exacerbate these effects, but the exposure-response data are presently lacking to derive an RfC. The EPA Diesel HAD states, "With DPM [diesel particulate matter] being a

ubiquitous component of ambient PM, there is an uncertainty about the adequacy of the existing DE [diesel exhaust] noncancer database to identify all of the pertinent DE-caused noncancer health hazards" (p. 9–19).

The Diesel HAD also briefly summarizes health effects associated with ambient PM and discusses the EPA's annual National Ambient Air Quality Standard (NAAQS) of $15 \mu\text{g}/\text{m}^3$. There is a much more extensive body of human data showing a wide spectrum of adverse health effects associated with exposure to ambient PM, of which diesel exhaust is an important component. The $\text{PM}_{2.5}$ NAAQS is designed to provide protection from the noncancer and premature mortality effects of $\text{PM}_{2.5}$ as a whole, of which diesel PM is a constituent.

c. Gasoline PM

Beyond the specific areas of quantifiable risk discussed above in section III.C, EPA is also currently investigating gasoline PM. Gasoline exhaust is a complex mixture that has not been evaluated in EPA's IRIS. Gasoline exhaust is a ubiquitous source of particulate matter, contributing to the health effects observed for ambient PM which is discussed extensively in the EPA Particulate Matter Criteria Document.⁹¹ The PM Criteria Document notes that the PM components of gasoline and diesel engine exhaust are hypothesized, important contributors to the observed increases in lung cancer incidence and mortality associated with ambient $\text{PM}_{2.5}$.⁹² Gasoline PM is also a component of near-roadway emissions that may be contributing to the health effects observed in people who live near roadways (see section III.F). There is also emerging evidence for the mutagenicity and cytotoxicity of gasoline exhaust and gasoline PM. Seagrave et al. investigated the combined particulate and semivolatile organic fractions of gasoline engine emissions in various animal and bioassay tests.⁹³ The authors suggest

that emissions from gasoline engines are mutagenic and can induce inflammation and have cytotoxic effects.

EPA is working to improve the understanding of PM emissions from gasoline engines, including the potential range of emissions and factors that influence emissions. EPA led a cooperative test program that recently completed testing approximately 500 randomly procured vehicles in the Kansas City metropolitan area. The purpose of this study was to determine the distribution of gasoline PM emissions from the in-use light-duty fleet. Results from this study are expected to be available shortly. Preliminary results from this work show the influence of high emitters on overall gasoline PM emissions and, also, that gasoline PM emissions increase at lower ambient temperatures in the in-use fleet. Some source apportionment studies show gasoline and diesel PM can result in larger contributions to ambient PM than predicted by EPA emission inventories.^{94 95} These source apportionment studies were one impetus behind conducting the Kansas City study.

Another issue related to gasoline PM is the effect of gasoline vehicles and engines on ambient PM, especially secondary PM. Ambient PM is composed of primary PM emitted directly into the atmosphere and secondary PM that is formed from chemical reactions in the atmosphere. The issue of secondary organic aerosol formation from aromatic precursors such as toluene is an important one to which EPA and others are paying significant attention. This is discussed in more detail in section 1.4.1 of the RIA.

d. Near-Roadway Health Effects

Another approach to investigating the collective health effects of mobile source contaminants is to examine associations between living near major roads and different adverse health endpoints. These studies generally examine people living near heavily-trafficked roadways, typically within several hundred meters, where fresh

Organic Fractions of Gasoline and Diesel Engine Emissions. *Toxicological Sciences* 70:212–226.

⁹⁴ Fujita, E.; Watson, M.J.; Chow, M.C.; et al. (1998) Northern Front Range Air Quality Study, Volume C: Source apportionment and simulation methods and evaluation. Prepared for Colorado State University, Cooperative Institute for Research in the Atmosphere, by Desert Research Institute, Reno, NV.

⁹⁵ Schauer, J.J.; Rogge, W.F.; Hildemann, L.M.; et al. (1996) Source apportionment of airborne particulate matter using organic compounds as tracers. *Atmos. Environ.* 30(22):3837–3855.

⁸⁷ Ishinishi, N.; Kuwabara, N.; Takaki, Y.; et al. (1988) Long-term inhalation experiments on diesel exhaust. In: Diesel exhaust and health risks. Results of the HERP studies. Ibaraki, Japan: Research Committee for HERP Studies; pp. 11–84.

⁸⁸ Heinrich, U.; Fuhst, R.; Rittinghausen, S.; et al. (1995) Chronic inhalation exposure of Wistar rats and two different strains of mice to diesel engine exhaust, carbon black, and titanium dioxide. *Inhal. Toxicol.* 7:553–556.

⁸⁹ Mauderly, J.L.; Jones, R.K.; Griffith, W.C.; et al. (1987) Diesel exhaust is a pulmonary carcinogen in rats exposed chronically by inhalation. *Fundam. Appl. Toxicol.* 9:208–221.

⁹⁰ Nikula, K.J.; Snipes, M.B.; Barr, E.B.; et al. (1995) Comparative pulmonary toxicities and carcinogenicities of chronically inhaled diesel exhaust and carbon black in F344 rats. *Fundam. Appl. Toxicol.* 25:80–94.

⁹¹ U.S. EPA (2004) Air Quality Criteria for Particulate Matter: Volume 1. Research Triangle Park, NC: National Center for Environmental Assessment—RTP Office; Report No. EPA/600/P-99/002aF. Enter report number at the following search page, <http://yosemite.epa.gov/ncepihom/nsCatalog.nsf/SearchPubs?Openform>.

⁹² U.S. EPA (2004) Air Quality Criteria for Particulate Matter: Volume 1. Research Triangle Park, NC: National Center for Environmental Assessment—RTP Office; Report No. EPA/600/P-99/002aF, p. 8–318. Enter report number at the following search page, <http://yosemite.epa.gov/ncepihom/nsCatalog.nsf/SearchPubs?Openform>.

⁹³ Seagrave, J.; McDonald, J.D.; Gigliotti, A.P.; Nikula, K.J.; Seilkop, S.K.; Gurevich, M. and Mauderly, J.L. (2002) Mutagenicity and in Vivo Toxicity of Combined Particulate and Semivolatile

emissions from motor vehicles are not yet fully diluted with background air.

Several studies have measured elevated concentrations of pollutants emitted directly by motor vehicles near roadways as compared to overall urban background levels. These elevated concentrations generally occur within approximately 200 meters of the road, although the distance may vary depending on traffic and environmental conditions. Pollutants measured with elevated concentrations include benzene, polycyclic aromatic hydrocarbons, carbon monoxide, nitrogen dioxide, black carbon, and coarse, fine, and ultrafine particulate matter. In addition, concentrations of road dust, and wear particles from tire and brake use also show concentration increases in proximity of major roadways.

The near-roadway health studies provide stronger evidence for some health endpoints than others. Evidence of adverse responses to traffic-related pollution is strongest for non-allergic respiratory symptoms, cardiovascular effects, premature adult mortality, and adverse birth outcomes, including low birth weight and size. Some evidence for new onset asthma is available, but not all studies have significant correlations. Lastly, among studies of childhood cancer, in particular childhood leukemia, evidence is inconsistent. Several small studies report positive associations, though such effects have not been observed in two larger studies. As described above, benzene and 1,3-butadiene are both known human leukemogens in adults. As previously mentioned, there is evidence of increased risk of leukemia among children whose parents have been occupationally exposed to benzene. Though the near-roadway studies are equivocal, taken together with the laboratory studies and other exposure environments, the data suggest a potentially serious children's health concern could exist. Additional research is needed to determine the significance of this potential concern.

Significant scientific uncertainties remain in our understanding of the relationship between adverse health effects and near-road exposure, including the exposures of greatest concern, the importance of chronic versus acute exposures, the role of fuel type (e.g. diesel or gasoline) and composition (e.g., % aromatics), relevant traffic patterns, the role of co-stressors including noise and socioeconomic status, and the role of differential susceptibility within the "exposed" populations. For a more

detailed discussion, see Chapter 3 of the Regulatory Impact Analysis.

These studies provide qualitative evidence that reducing emissions from on-road mobile sources will provide public health benefits beyond those that can be quantified using currently available information.

C. Ozone

Many MSATs are part of a larger category of mobile source emissions known as volatile organic compounds (VOCs), which contribute to the formation of ozone. Mobile sources contribute significantly to national emissions of VOCs. In addition, PFCs are a source of VOCs. The vehicle and PFC standards in this final rule will help reduce emissions of VOCs.

1. Background

Ground-level ozone pollution is formed by the reaction of VOCs and nitrogen oxides (NO_x) in the lower atmosphere in the presence of heat and sunlight. These pollutants, often referred to as ozone precursors, are emitted by many types of pollution sources, such as highway and nonroad motor vehicles and engines, power plants, chemical plants, refineries, makers of consumer and commercial products, industrial facilities, and smaller area sources. The PFC controls being finalized in this action will help reduce VOC emissions by reducing evaporation, permeation and spillage from PFCs. The vehicle controls being finalized will also reduce VOC emissions; however, because these reductions will occur at cold temperatures the ozone benefits will be limited.

The science of ozone formation, transport, and accumulation is complex.⁹⁶ Ground-level ozone is produced and destroyed in a cyclical set of chemical reactions, many of which are sensitive to temperature and sunlight. When ambient temperatures and sunlight levels remain high for several days and the air is relatively stagnant, ozone and its precursors can build up and result in more ozone than typically would occur on a single high-temperature day. Ozone also can be transported into an area from pollution sources found hundreds of miles upwind, resulting in elevated ozone levels even in areas with low VOC or NO_x emissions.

The current ozone National Ambient Air Quality Standards (NAAQS)

⁹⁶ U.S. EPA, Air Quality Criteria for Ozone and Related Photochemical Oxidants (Final). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-05/004aF-cF, 2006. This document is available in Docket EPA-HQ-OAR-2005-0036.

established by EPA in 1997 has an 8-hour averaging time.⁹⁷ The 8-hour ozone NAAQS is based on well-documented science demonstrating that more people were experiencing adverse health effects at lower levels of exertion, over longer periods, and at lower ozone concentrations than addressed by the previous one-hour ozone NAAQS. The current ozone NAAQS addresses ozone exposures of concern for the general population and populations most at risk, including children active outdoors, outdoor workers, and individuals with pre-existing respiratory disease, such as asthma. The 8-hour ozone NAAQS is met at an ambient air quality monitoring site when the average of the annual fourth-highest daily maximum 8-hour average ozone concentration over three years is less than or equal to 0.084 ppm.

2. Health Effects of Ozone

The health and welfare effects of ozone are well documented and are assessed in the EPA's 2006 ozone Air Quality Criteria Document (ozone AQCD) and EPA staff papers.^{98,99} Ozone can irritate the respiratory system, causing coughing, throat irritation, and/or uncomfortable sensation in the chest. Ozone can reduce lung function and make it more difficult to breathe deeply, and breathing may become more rapid and shallow than normal, thereby limiting a person's activity. Ozone can also aggravate asthma, leading to more asthma attacks that require a doctor's attention and/or the use of additional medication. Animal toxicologic evidence indicates that with repeated exposure, ozone can inflame and damage the lining of the lungs, which may lead to permanent changes in lung tissue and irreversible reductions in lung function. People who are more susceptible to effects associated with exposure to ozone include children, the elderly, and individuals with respiratory disease such as asthma. There is also suggestive evidence that certain people may have greater genetic susceptibility. Those with greater exposures to ozone, for instance due to time spent outdoors (e.g., outdoor workers), are also of concern.

⁹⁷ EPA's review of the ozone NAAQS is underway and a proposal is scheduled for June 2007 with a final rule scheduled for March 2008.

⁹⁸ U.S. EPA, Air Quality Criteria for Ozone and Related Photochemical Oxidants (Final). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-05/004aF-cF, 2006. This document is available in Docket EPA-HQ-OAR-2005-0036.

⁹⁹ U.S. EPA (2007) Review of National Ambient Air Quality Standards for Ozone, Assessment of Scientific and Technical Information, OAQPS Staff Paper, EPA-452/R-07-003. This document is available in Docket EPA-HQ-OAR-2005-0036.

The recent ozone AQCD also examined relevant new scientific information which has emerged in the past decade, including the impact of ozone exposure on such health effects as changes in lung structure and biochemistry, inflammation of the lungs, exacerbation and causation of asthma, respiratory illness-related school absence, hospital admissions and premature mortality. Animal toxicologic studies have suggested potential interactions between ozone and PM with increased responses observed to mixtures of the two pollutants compared to either ozone or PM alone. The respiratory morbidity observed in animal studies along with the evidence from epidemiologic studies supports a causal relationship between acute ambient ozone exposures and increased respiratory-related emergency room visits and hospitalizations in the warm season. In addition, there is suggestive evidence of a contribution of ozone to cardiovascular-related morbidity and non-accidental and cardiopulmonary mortality.

3. Plant and Ecosystem Effects of Ozone

Ozone contributes to many environmental effects, with impacts to plants and ecosystems being of most concern. Ozone can produce both acute and chronic injury in sensitive species depending on the concentration level and the duration of the exposure. Ozone effects also tend to accumulate over the growing season of the plant, so that even lower concentrations experienced for a longer duration have the potential to create chronic stress on vegetation. Ozone damage to plants includes visible injury to leaves and a reduction in food production through impaired photosynthesis, both of which can lead to reduced crop yields, forestry production, and use of sensitive ornamentals in landscaping. In addition, the reduced food production in plants and subsequent reduced root growth and storage below ground, can result in other, more subtle plant and ecosystems impacts. These include increased susceptibility of plants to insect attack, disease, harsh weather, interspecies competition and overall decreased plant vigor. The adverse effects of ozone on forest and other natural vegetation can potentially lead to species shifts and loss from the affected ecosystems, resulting in a loss or reduction in associated ecosystem goods and services. Lastly, visible ozone injury to leaves can result in a loss of aesthetic value in areas of special scenic significance like national parks and wilderness areas. The final 2006 ozone AQCD presents more detailed

information on ozone effects on vegetation and ecosystems.

4. Current and Projected 8-hour Ozone Levels

Currently, ozone concentrations exceeding the level of the 8-hour ozone NAAQS occur over wide geographic areas, including most of the nation's major population centers.¹⁰⁰ As of October 2006 approximately 157 million people live in the 116 areas that are currently designated as not in attainment with the 8-hour ozone NAAQS. There are 461 full or partial counties that make up the 116 8-hour ozone nonattainment areas.

EPA has already adopted many emission control programs that are expected to reduce ambient ozone levels. These control programs include the Clean Air Interstate Rule (70 FR 25162, May 12, 2005), as well as many mobile source rules (many of which are described in section V.D). As a result of these programs, the number of areas that fail to meet the 8-hour ozone NAAQS is expected to decrease.

Based on the recent ozone modeling performed for the CAIR analysis,¹⁰¹ barring additional local ozone precursor controls, we estimate 37 Eastern counties (where 24 million people are projected to live) will exceed the 8-hour ozone NAAQS in 2010. An additional 148 Eastern counties (where 61 million people are projected to live) are expected to be within 10 percent of violating the 8-hour ozone NAAQS in 2010.

States with 8-hour ozone nonattainment areas will be required to take action to bring these areas into compliance in the future. Based on the final rule designating and classifying 8-hour ozone nonattainment areas (69 FR 23951, April 30, 2004), most 8-hour ozone nonattainment areas will be required to attain the 8-hour ozone NAAQS in the 2007 to 2013 time frame and then be required to maintain the 8-hour ozone NAAQS thereafter.¹⁰² The expected ozone inventory reductions from the standards being finalized in this action may be useful to states in attaining or maintaining the 8-hour ozone NAAQS.

EPA's review of the ozone NAAQS is currently underway and a proposed decision in this review is scheduled for

June 2007 with a final rule scheduled for March 2008. If the ozone NAAQS is revised, then new nonattainment areas could be designated. While EPA is not relying on it for purposes of justifying this rule, the emission reductions from this rulemaking would also be helpful to states if there is an ozone NAAQS revision.

D. Particulate Matter

The cold temperature vehicle controls being finalized here will result in reductions of primary PM being emitted by vehicles. In addition, both the vehicle controls and the PFC controls will reduce VOCs that react in the atmosphere to form secondary PM_{2.5}, namely organic carbonaceous PM_{2.5}.

1. Background

Particulate matter (PM) represents a broad class of chemically and physically diverse substances. It can be principally characterized as discrete particles that exist in the condensed (liquid or solid) phase spanning several orders of magnitude in size. PM is further described by breaking it down into size fractions. PM₁₀ refers to particles generally less than or equal to 10 micrometers (μm) in diameter. PM_{2.5} refers to fine particles, those particles generally less than or equal to 2.5 μm in diameter. Inhalable (or "thoracic") coarse particles refer to those particles generally greater than 2.5 μm but less than or equal to 10 μm in diameter. Ultrafine PM refers to particles with diameters generally less than 100 nanometers (0.1 μm). Larger particles (>10 μm) tend to be removed by the respiratory clearance mechanisms, whereas smaller particles are deposited deeper in the lungs.

Fine particles are produced primarily by combustion processes and by transformations of gaseous emissions (e.g., SO_x, NO_x and VOCs) in the atmosphere. The chemical and physical properties of PM_{2.5} may vary greatly with time, region, meteorology and source category. Thus, PM_{2.5} may include a complex mixture of different pollutants including sulfates, nitrates, organic compounds, elemental carbon and metal compounds. These particles can remain in the atmosphere for days to weeks and travel through the atmosphere hundreds to thousands of kilometers.

EPA has recently amended the PM NAAQS (71 FR 61144, October 17, 2006). The final rule, signed on September 21, 2006 and published on October 17, 2006, addressed revisions to the primary and secondary NAAQS for PM to provide increased protection of public health and welfare, respectively.

¹⁰⁰ A map of the 8-hour ozone nonattainment areas is included in the RIA for this rule.

¹⁰¹ Technical Support Document for the Final Clean Air Interstate Rule Air Quality Modeling. This document is available in Docket EPA-HQ-OAR-2005-0036.

¹⁰² The Los Angeles South Coast Air Basin 8-hour ozone nonattainment area will have to attain before June 15, 2021.

The primary PM_{2.5} NAAQS include a short-term (24-hour) and a long-term (annual) standard. The level of the 24-hour PM_{2.5} NAAQS has been revised from 65 µg/m³ to 35 µg/m³ to provide increased protection against health effects associated with short-term exposures to fine particles. The current form of the 24-hour PM_{2.5} standard was retained (e.g., based on the 98th percentile concentration averaged over three years). The level of the annual PM_{2.5} NAAQS was retained at 15 µg/m³ continuing protection against health effects associated with long-term exposures. The current form of the annual PM_{2.5} standard was retained as an annual arithmetic mean averaged over three years, however, the following two aspects of the spatial averaging criteria were narrowed: (1) The annual mean concentration at each site shall be within 10 percent of the spatially averaged annual mean, and (2) the daily values for each monitoring site pair shall yield a correlation coefficient of at least 0.9 for each calendar quarter. With regard to the primary PM₁₀ standards, the 24-hour PM₁₀ NAAQS was retained at a level of 150 µg/m³ not to be exceeded more than once per year on average over a three-year period. Given that the available evidence does not suggest an association between long-term exposure to coarse particles at current ambient levels and health effects, EPA has revoked the annual PM₁₀ standard.

With regard to the secondary PM standards, EPA has revised these standards to be identical in all respects to the revised primary standards. Specifically, EPA has revised the current 24-hour PM_{2.5} secondary standard by making it identical to the revised 24-hour PM_{2.5} primary standard, retained the annual PM_{2.5} and 24-hour PM₁₀ secondary standards, and revoked the annual PM₁₀ secondary standards. This suite of secondary PM standards is intended to provide protection against PM-related public welfare effects, including visibility impairment, effects on vegetation and ecosystems, and material damage and soiling.

2. Health Effects of PM

Scientific studies show ambient PM is associated with a series of adverse health effects. These health effects are discussed in detail in the 2004 Particulate Matter Air Quality Criteria Document (PM AQCD) as well as the

2005 PM Staff Paper.^{103, 104} Further discussion of health effects associated with PM can also be found in the RIA for this final rule.

Health effects associated with short-term exposures (e.g. hours to days) in ambient PM_{2.5} include premature mortality, increased hospital admissions, heart and lung diseases, increased cough, adverse lower-respiratory symptoms, decrements in lung function and changes in heart rate rhythm and other cardiac effects. Studies examining populations exposed to different levels of air pollution over a number of years, including the Harvard Six Cities Study and the American Cancer Society Study, show associations between long-term exposure to ambient PM_{2.5} and both total and cardiorespiratory mortality. In addition, the reanalysis of the American Cancer Society cohort shows an association between fine particle and sulfate concentrations and lung cancer mortality.

Recently, several studies have highlighted the adverse effects of PM specifically from mobile sources.^{105, 106} Studies have also focused on health effects due to PM exposures on or near roadways.¹⁰⁷ Although these studies include all air pollution sources, including both spark-ignition (gasoline) and diesel powered vehicles, they indicate that exposure to PM emissions near roadways, thus dominated by mobile sources, are associated with health effects. Additional information on near-roadway health effects can be found in section III.B.2.d of this preamble.

¹⁰³ U.S. EPA (2004) Air Quality Criteria for Particulate Matter (Oct 2004), Volume I Document No. EPA600/P-99/002aF and Volume II Document No. EPA600/P-99/002bF. This document is available in Docket EPA-HQ-OAR-2005-0036.

¹⁰⁴ U.S. EPA (2005) Review of the National Ambient Air Quality Standard for Particulate Matter: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper. EPA-452/R-05-005. This document is available in Docket EPA-HQ-OAR-2005-0036.

¹⁰⁵ Laden, F.; Neas, L.M.; Dockery, D.W.; Schwartz, J. (2000) Association of Fine Particulate Matter from Different Sources with Daily Mortality in Six U.S. Cities. *Environmental Health Perspectives* 108: 941-947.

¹⁰⁶ Janssen, N.A.H.; Schwartz, J.; Zanobetti, A.; Suh, H.H. (2002) Air Conditioning and Source-Specific Particles as Modifiers of the Effect of PM₁₀ on Hospital Admissions for Heart and Lung Disease. *Environmental Health Perspectives* 110: 43-49.

¹⁰⁷ Riediker, M.; Cascio, W.E.; Griggs, T.R.; Herbst, M.C.; Bromberg, P.A.; Neas, L.; Williams, R.W.; Devlin, R.B. (2003) Particulate Matter Exposures in Cars is Associated with Cardiovascular Effects in Healthy Young Men. *Am. J. Respir. Crit. Care Med.* 169: 934-940.

3. Welfare Effects of PM

a. Visibility

i. Background

Visibility can be defined as the degree to which the atmosphere is transparent to visible light.¹⁰⁸ Visibility impairment manifests in two principal ways: as local visibility impairment and as regional haze.¹⁰⁹ Local visibility impairment may take the form of a localized plume, a band or layer of discoloration appearing well above the terrain as a result from complex local meteorological conditions. Alternatively, local visibility impairment may manifest as an urban haze, sometimes referred to as a "brown cloud." This urban haze is largely caused by emissions from multiple sources in the urban areas and is not typically attributable to only one nearby source or to long-range transport. The second type of visibility impairment, regional haze, usually results from multiple pollution sources spread over a large geographic region. Regional haze can impair visibility over large regions and across states.

Visibility is important because it has direct significance to people's enjoyment of daily activities in all parts of the country. Individuals value good visibility for the well-being it provides them directly, where they live and work, and in places where they enjoy recreational opportunities. Visibility is also highly valued in significant natural areas such as national parks and wilderness areas, and special emphasis is given to protecting visibility in these areas. For more information on visibility see the 2004 PM AQCD as well as the 2005 PM Staff Paper.^{110 111}

Fine particles are the major cause of reduced visibility in parts of the United

¹⁰⁸ National Research Council, 1993. Protecting Visibility in National Parks and Wilderness Areas. National Academy of Sciences Committee on Haze in National Parks and Wilderness Areas. National Academy Press, Washington, DC. This document is available in Docket EPA-HQ-OAR-2005-0036. This book can be viewed on the National Academy Press Web site at <http://www.nap.edu/books/0309048443/html/>.

¹⁰⁹ See discussion in U.S. EPA, National Ambient Air Quality Standards for Particulate Matter; Proposed Rule; January 17, 2006, Vol 71, p. 2676. This information is available electronically at <http://epa.gov/fedrgstr/EPA-AIR/2006/January/Day-17/a177.pdf>.

¹¹⁰ U.S. EPA (2004) Air Quality Criteria for Particulate Matter (Oct 2004), Volume I Document No. EPA600/P-99/002aF and Volume II Document No. EPA600/P-99/002bF. This document is available in Docket EPA-HQ-OAR-2005-0036.

¹¹¹ U.S. EPA (2005) Review of the National Ambient Air Quality Standard for Particulate Matter: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper. EPA-452/R-05-005. This document is available in Docket EPA-HQ-OAR-2005-0036.

States. To address the welfare effects of PM on visibility, EPA set secondary PM_{2.5} standards which would act in conjunction with the establishment of a regional haze program. In setting this secondary standard, EPA concluded that PM_{2.5} causes adverse effects on visibility in various locations, depending on PM concentrations and factors such as chemical composition and average relative humidity. The secondary (welfare-based) PM_{2.5} NAAQS was established as equal to the suite of primary (health-based) NAAQS. Furthermore, section 169 of the Act provides additional authorities to remedy existing visibility impairment and prevent future visibility impairment in the 156 national parks, forests and wilderness areas categorized as mandatory class I federal areas (62 FR 38680–81, July 18, 1997).¹¹² In July 1999 the regional haze rule (64 FR 35714) was put in place to protect the visibility in mandatory class I federal areas. Visibility can be said to be impaired in both PM_{2.5} nonattainment areas and mandatory class I federal areas.

ii. Current Visibility Impairment

Recently designated PM_{2.5} nonattainment areas indicate that, as of October 2006, almost 90 million people live in nonattainment areas for the 1997 PM_{2.5} NAAQS. Thus, at least these populations would likely be experiencing visibility impairment, as well as many thousands of individuals who travel to these areas. In addition, while visibility trends have improved in mandatory class I federal areas, the most recent data show that these areas continue to suffer from visibility impairment.¹¹³ In summary, visibility impairment is experienced throughout the U.S., in multi-state regions, urban areas, and remote mandatory class I federal areas.^{114 115} The mandatory class I federal areas are listed in Chapter 3 of the RIA for this action. The areas that have design values above the 1997 PM_{2.5} NAAQS are also listed in Chapter 3 of the RIA for this action.

¹¹² These areas are defined in section 162 of the Act as those national parks exceeding 6,000 acres, wilderness areas and memorial parks exceeding 5,000 acres, and all international parks which were in existence on August 7, 1977.

¹¹³ U.S. EPA, Regulatory Impact Analysis for the Final Clean Air Interstate Rule. This document is available in Docket EPA–HQ–OAR–2005–0036.

¹¹⁴ U.S. EPA, Air Quality Designations and Classifications for the Fine Particles (PM_{2.5}) National Ambient Air Quality Standards, December 17, 2004. (70 FR 943, January 5, 2005) This document is also available on the web at: <http://www.epa.gov/pmdesignations/>.

¹¹⁵ U.S. EPA, Regional Haze Regulations, July 1, 1999. (64 FR 35714, July 1, 1999)

iii. Future Visibility Impairment

Recent modeling for the Clean Air Interstate Rule (CAIR) was used to project visibility conditions in mandatory class I federal areas across the country in 2015. The results for the mandatory class I federal areas suggest that these areas are predicted to continue to have annual average deciview levels above background in the future.¹¹⁶ Modeling done for the PM NAAQS also projected PM_{2.5} levels in 2015. These projections include all sources of PM_{2.5}, including the engines covered in this rule, and suggest that PM_{2.5} levels above the NAAQS will persist into the future.

The vehicles that will be subject to the standards contribute to visibility concerns in these areas through both their primary PM emissions and their VOC emissions, which contribute to the formation of secondary PM_{2.5}. The PFCs that will be subject to the standards also contribute to visibility concerns through their VOC emissions. Reductions in these direct PM and VOC emissions will help to improve visibility across the nation, including mandatory class I federal areas.

b. Atmospheric Deposition

Wet and dry deposition of ambient particulate matter delivers a complex mixture of metals (e.g., mercury, zinc, lead, nickel, aluminum, cadmium), organic compounds (e.g., POM, dioxins, furans) and inorganic compounds (e.g., nitrate, sulfate) to terrestrial and aquatic ecosystems. EPA's Great Waters Program has identified 15 pollutants whose deposition to water bodies has contributed to the overall contamination loadings to these Great Waters. These 15 compounds include several heavy metals and a group known as polycyclic organic matter (POM). Within POM are the polycyclic aromatic hydrocarbons (PAHs). PAHs in the environment may be present in the gas or particle phase, although the bulk will be adsorbed onto airborne particulate matter. In most cases, human-made sources of PAHs account for the majority of PAHs released to the environment. The PAHs are usually the POMs of concern as many PAHs are probable human carcinogens.¹¹⁷ For some watersheds,

¹¹⁶ The deciview metric describes perceived visual changes in a linear fashion over its entire range, analogous to the decibel scale for sound. A deciview of 0 represents pristine conditions. The higher the deciview value, the worse the visibility, and an improvement in visibility is a decrease in deciview value.

¹¹⁷ Deposition of Air Pollutants to the Great Waters—Third Report to Congress, Office of Air Quality Planning and Standards, June 2000, EPA453–R–00–005. This document is available in Docket EPA–HQ–OAR–2005–0036.

atmospheric deposition represents a significant input to the total surface water PAH burden.^{118 119} Emissions from mobile sources have been found to account for a percentage of the atmospheric deposition of PAHs. For instance, recent studies have reported gasoline and diesel vehicles as major contributors in the atmospheric deposition of PAHs to Chesapeake Bay, Massachusetts Bay and Casco Bay.^{120 121} The vehicle controls being finalized may help to reduce deposition of heavy metals and POM.

c. Materials Damage and Soiling

The deposition of airborne particles can also reduce the aesthetic appeal of buildings and culturally important articles through soiling, and can contribute directly (or in conjunction with other pollutants) to structural damage by means of corrosion or erosion.¹²² Particles affect materials principally by promoting and accelerating the corrosion of metals, by degrading paints, and by deteriorating building materials such as concrete and limestone. Particles contribute to these effects because of their electrolytic, hygroscopic, and acidic properties, and their ability to sorb corrosive gases (principally sulfur dioxide). The rate of metal corrosion depends on a number of factors, including the deposition rate and nature of the pollutant; the influence of the metal protective corrosion film; the amount of moisture present; variability in the electrochemical reactions; the presence and concentration of other surface electrolytes; and the orientation of the metal surface.

¹¹⁸ Simcik, M.F.; Eisenrich, S.J.; Golden, K.A.; Liu, S.; Lipiatou, E.; Swackhamer, D.L.; and Long, D.T. (1996) Atmospheric Loading of Polycyclic Aromatic Hydrocarbons to Lake Michigan as Recorded in the Sediments. *Environ. Sci. Technol.* 30:3039–3046.

¹¹⁹ Simcik, M.F.; Eisenrich, S.J.; and Liou, P.J. (1999) Source Apportionment and Source/Sink Relationships of PAHs in the Coastal Atmosphere of Chicago and Lake Michigan. *Atmospheric Environment* 33: 5071–5079.

¹²⁰ Dickhut, R.M.; Canuel, E.A.; Gustafson, K.E.; Liu, K.; Arzayus, K.M.; Walker, S.E.; Edgecombe, G.; Gaylor, M.O.; and McDonald, E.H. (2000) Automotive Sources of Carcinogenic Polycyclic Aromatic Hydrocarbons Associated with Particulate Matter in the Chesapeake Bay Region. *Environ. Sci. Technol.* 34: 4635–4640.

¹²¹ Golomb, D.; Barry, E.; Fisher, G.; Varanusupakul, P.; Koleda, M.; and Rooney, T. (2001) Atmospheric Deposition of Polycyclic Aromatic Hydrocarbons near New England Coastal Waters. *Atmospheric Environment* 35: 6245–6258.

¹²² U.S. EPA (2005) Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper. This document is available in Docket EPA–HQ–OAR–2005–0036.

4. Current and Projected PM_{2.5} Levels
 In 2005 EPA designated 39 nonattainment areas for the 1997 PM_{2.5} NAAQS based on air quality design values (using 2001–2003 or 2002–2004 measurements) and a number of other factors.¹²³ (See 70 FR 943, January 5, 2005; 70 FR 19844, April 14, 2005.)

These areas are comprised of 208 full or partial counties with a total population exceeding 88 million. As mentioned in section III.D.1, the 1997 PM_{2.5} NAAQS was recently revised and the 2006 PM_{2.5} NAAQS became effective on December 18, 2006. Table III.D–1 presents the number of counties in areas currently

designated as nonattainment for the 1997 PM_{2.5} NAAQS as well as the number of additional counties which have monitored data that is violating the 2006 PM_{2.5} NAAQS. Nonattainment areas will be designated with respect to the new 2006 PM_{2.5} NAAQS in early 2010.

TABLE III.D–1.—PM_{2.5} STANDARDS: CURRENT NONATTAINMENT AREAS AND OTHER VIOLATING COUNTIES

	Number of counties	Population ¹
1997 PM _{2.5} Standards: 39 areas currently designated	208	88,394,000
2006 PM _{2.5} Standards: Counties with violating monitors ²	49	18,198,676
Total	257	106,592,676

¹ Population numbers are from 2000 census data.

² This table provides an estimate of the counties violating the 2006 PM_{2.5} NAAQS based on 2003–05 air quality data. The areas designated as nonattainment for the 2006 PM_{2.5} NAAQS will be based on 3 years of air quality data from later years. Also, the county numbers in the summary table include only the counties with monitors violating the 2006 PM_{2.5} NAAQS. The monitored county violations may be an underestimate of the number of counties and populations that will eventually be included in areas with multiple counties designated nonattainment.

Based on modeling performed for the PM NAAQS analysis, we estimate that 52 counties (where 53 million people are projected to live) will exceed the 2006 PM_{2.5} standard in 2015.¹²⁴ ¹²⁵ In addition, 54 counties (where 27 million people are projected to live) are expected to be within 10 percent of violating the 2006 PM_{2.5} NAAQS in 2015.

Areas designated as not attaining the 1997 PM_{2.5} NAAQS will need to attain these standards in the 2010 to 2015 time frame, and then be required to maintain the NAAQS thereafter. The attainment dates associated with the potential nonattainment areas based on the 2006 PM_{2.5} NAAQS would likely be in the 2015 to 2020 timeframe. The emissions standards being finalized in this action would become effective between 2009 and 2015, making the expected PM and VOC inventory reductions useful to states in attaining or maintaining the PM_{2.5} NAAQS.

5. Current PM₁₀ Levels

Air quality monitoring data indicates that as of October 2006 approximately 28.5 million people live in 46 designated PM₁₀ nonattainment areas, which include all or part of 46 counties. The RIA for this rule lists the PM₁₀

nonattainment areas and their populations, as of October 2006. The expected PM and VOC inventory reductions from the standards being finalized in this action could be useful to states in maintaining the PM₁₀ NAAQS.

IV. What Are the Emissions, Air Quality, and Public Health Impacts of This Rule?

A. Emissions Impacts of All Rule Provisions Combined

The emissions analysis presented in section IV.A of this preamble is described in more detail in Chapter 2.2.2. of the RIA. The emissions analysis has been updated since the proposal, largely to include the effects of the recently proposed Renewable Fuels Standard, which was required by the Energy Policy Act. The emissions analysis examines the 0.62 vol% standard but does not include the 1.3% maximum average, because of the lead time necessary to conduct inventory modeling. Thus, the emission reductions from highway vehicles and other sources attributable to the fuel benzene standard are underestimated in many areas of the country, particularly in areas where fuel benzene levels were highest without control, such as the

Northwest. This issue is discussed in more detail in the RIA.

1. How Will MSAT Emissions Be Reduced?

Figure IV.A–1 depicts the estimated reduction in total air toxic emissions emitted by mobile sources between 1990 and 2030, with and without the standards being finalized in this rule. These estimates do not include diesel PM. Trends in diesel PM emissions are discussed in the regulatory impact analysis for this rule. Without standards being finalized in this rule, emissions of air toxics from mobile sources will be reduced by about 70% percent between 1990 and 2030, from about 3.3 million tons to 1.3 million tons. This will occur despite a projected increase in vehicle miles traveled of over 100 percent, and a projected 150% increase in nonroad activity, based on units of work called horsepower hours. Without additional controls, air toxic emissions from mobile sources would begin to increase after 2015. Similar trends are observed for benzene (see Figure IV.A–2), with a reduction in emissions from about 380,000 tons in 1990 to less than 170,000 tons in 2030, but emissions from mobile sources begin to increase again after 2015.

¹²³ The full details involved in calculating a PM_{2.5} design value are given in Appendix N of 40 CFR Part 50.

¹²⁴ Note that this analysis identifies only counties projected to have a violating monitor; when

designated in the future, some areas may include additional contributing counties. Thus, the total number of counties designated in the future and the associated population would likely exceed these estimates.

¹²⁵ Regulatory Impact Analysis for the final PM NAAQS rule. This document is available in Docket EPA–HQ–OAR–2005–0036.

Figure IV.A-1. Estimated Reduction in Air Toxic Emissions Emitted by Mobile Sources, 1990 to 2030, With and Without Standards Being Finalized in this Rule

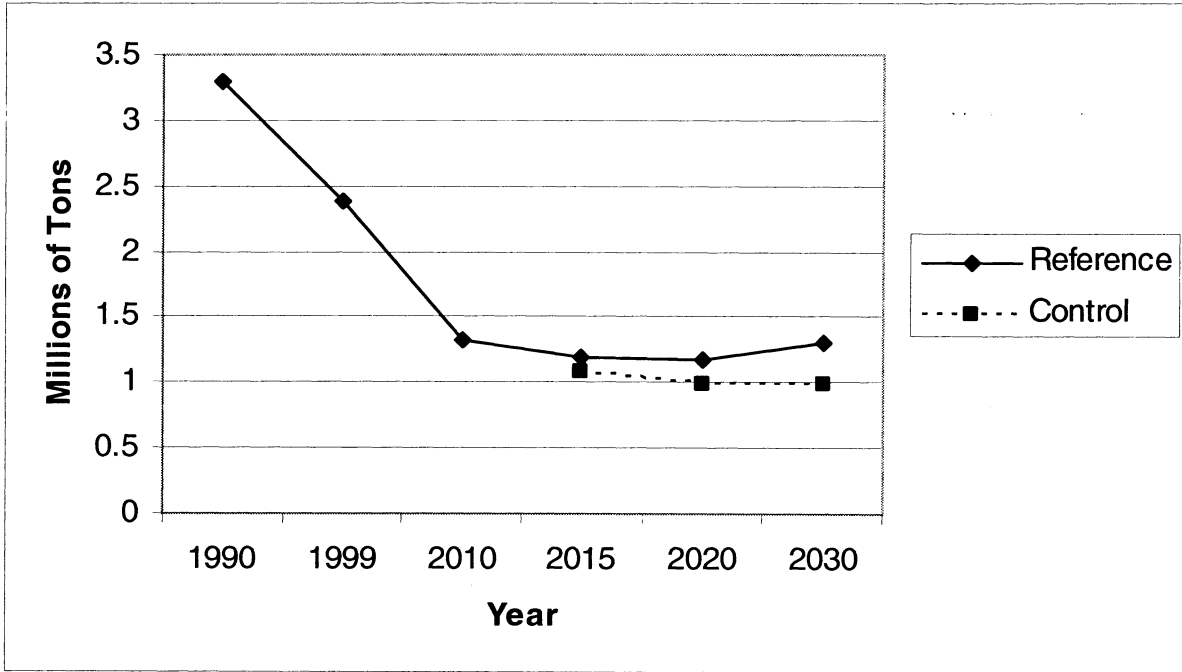
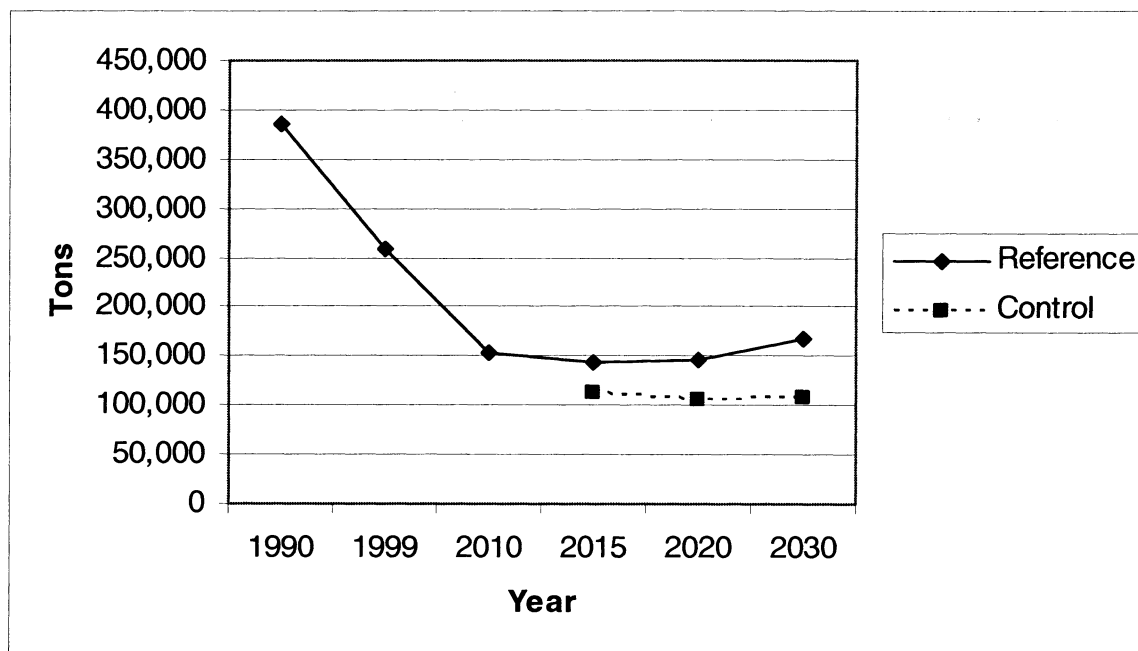


Figure IV.A-2. Estimated Reduction in Benzene Emissions Emitted by Mobile Sources, 1990 to 2030, With and Without Standards Being Finalized in this Rule



Total emissions of MSATs from mobile and stationary sources in 2030 will be 330,000 tons less than they would have been without this rule (Figure IV.A-3). Of these 330,000 tons of reductions, 310,000 will be from mobile sources, with the rest from portable fuel containers (PFCs) and gasoline distribution.¹²⁶ Table IV.A-1 summarizes MSAT reductions by source sector in 2015, 2020, and 2030. In addition, total benzene emissions from mobile and stationary sources will be

61,000 tons less than they would have been without this rule (Figure IV.A-4). Table IV.A-2 depicts reductions in benzene by source sector from this rule.

In 2030, annual benzene emissions from gasoline on-road mobile sources will be 45% lower as a result of this rule (Figure IV.A-5), and over 60% lower than they were in 1999. In addition, benzene emissions from gasoline nonroad equipment will be 14% lower in 2030, and over 45% lower than they were in 1999. Benzene emissions from PFCs will be reduced by almost 80% in

2030 (Figure IV.A-6), and benzene emissions from gasoline distribution by over 30% in 2030. For total MSAT emissions from on-road mobile sources, there will be a 38% reduction in MSAT emissions in 2030 (Figure IV.A-7), and a 65% reduction from 1999 levels.

Table IV.A-3 provides estimated reductions in emissions from individual MSATs in 2015, 2020 and 2030, from gasoline vehicles, gasoline nonroad engines, and PFCs as a result of the controls being finalized in this rule.

¹²⁶Reduction in fuel benzene will reduce emissions through the whole distribution chain.

Figure IV.A-3. Reductions in Total MSAT Emissions from All Sources Due to Standards Being Finalized in this Rule

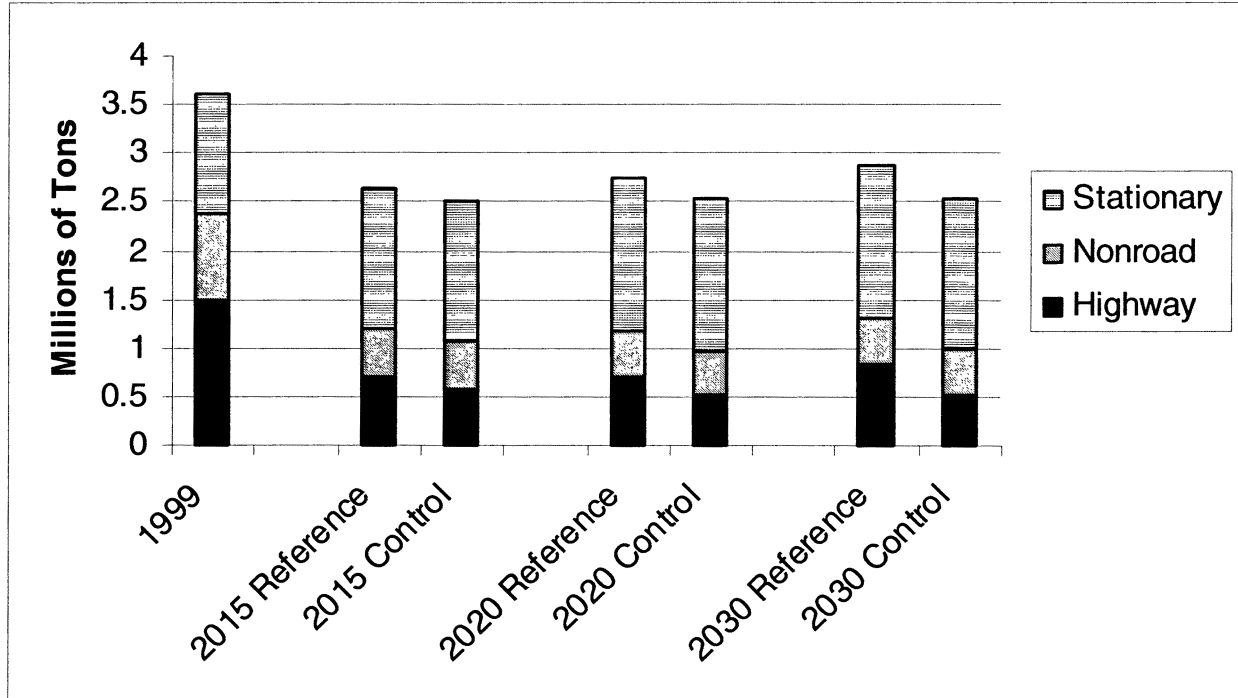


Figure IV.A-4. Reductions in Benzene Emissions from All Sources Due to Standards Being Finalized in this Rule

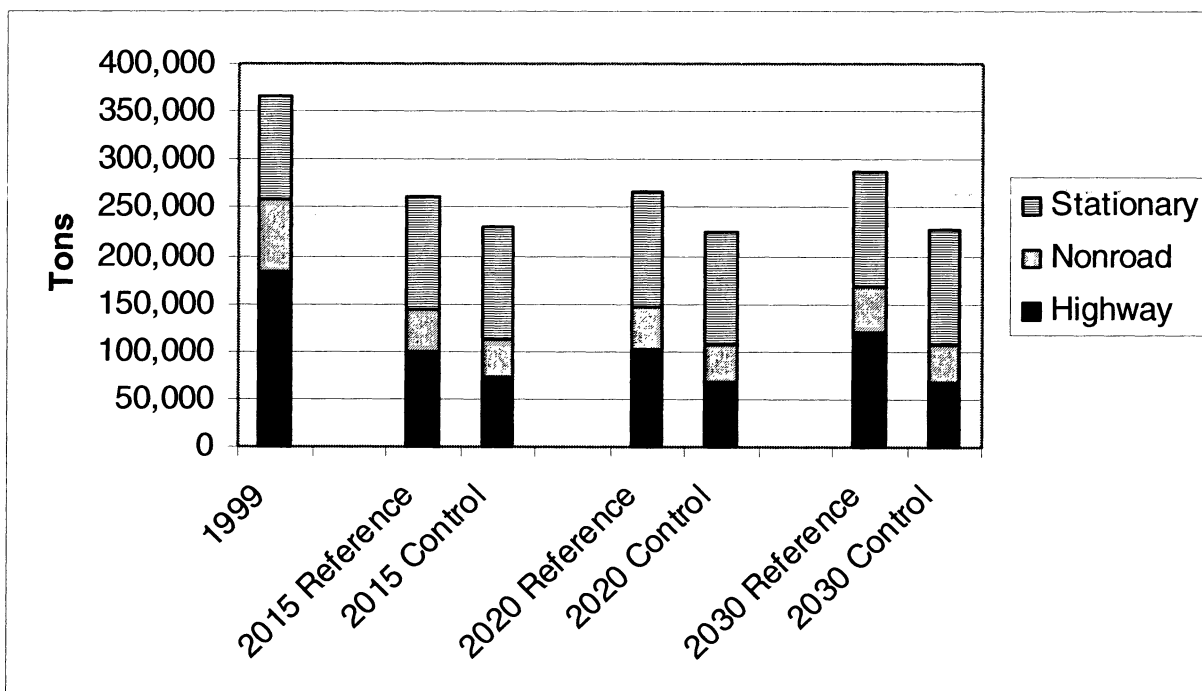


TABLE IV.A-1.—ESTIMATED REDUCTIONS IN MSAT EMISSIONS FROM ALL CONTROL MEASURES BY SECTOR, 2015 TO 2030

MSAT	1999	2015			2020			2030		
		Without rule (tons)	With rule (tons)	Reduction (tons)	Without rule (tons)	With rule (tons)	Reduction (tons)	Without rule (tons)	With rule (tons)	Reduction (tons)
Gasoline Onroad Mobile Sources	1,452,739	675,781	558,666	117,115	693,189	507,782	185,408	808,141	505,074	303,067
Gasoline Nonroad Mobile Sources	806,725	449,422	443,973	5,449	406,196	400,816	5,380	412,617	406,856	5,761
PFCs	37,166	27,355	9,893	17,462	29,338	10,672	18,666	33,430	12,264	21,166
Gasoline Distribution	57,765	62,870	62,059	811	64,942	64,092	850	64,942	64,092	850
Total	2,354,395	1,215,428	1,074,591	140,837	1,193,665	983,362	210,303	1,319,130	988,286	330,844

TABLE IV.A-2.—ESTIMATED REDUCTIONS IN BENZENE EMISSIONS FROM ALL CONTROL MEASURES BY SECTOR, 2015 TO 2030

Benzene	1999	2015			2020			2030		
		Without rule (tons)	With rule (tons)	Reduction (tons)	Without rule (tons)	With rule (tons)	Reduction (tons)	Without rule (tons)	With rule (tons)	Reduction (tons)
Gasoline Onroad Mobile Sources	183,660	97,789	71,688	26,101	101,514	65,878	35,636	119,016	65,601	53,415
Gasoline Nonroad Mobile Sources	68,589	41,343	35,825	5,518	40,161	34,717	5,444	42,994	37,167	5,827
PFCs	853	992	215	777	1,063	232	831	1,210	267	944
Gasoline Distribution	1,984	2,445	1,635	810	2,621	1,772	849	2,621	1,772	849
Total	255,086	142,569	109,363	33,206	145,359	102,599	42,760	165,841	104,807	61,035

Figure IV.A-5. Benzene Emission Reductions from Gasoline Onroad Mobile Sources

with All Controls in Place

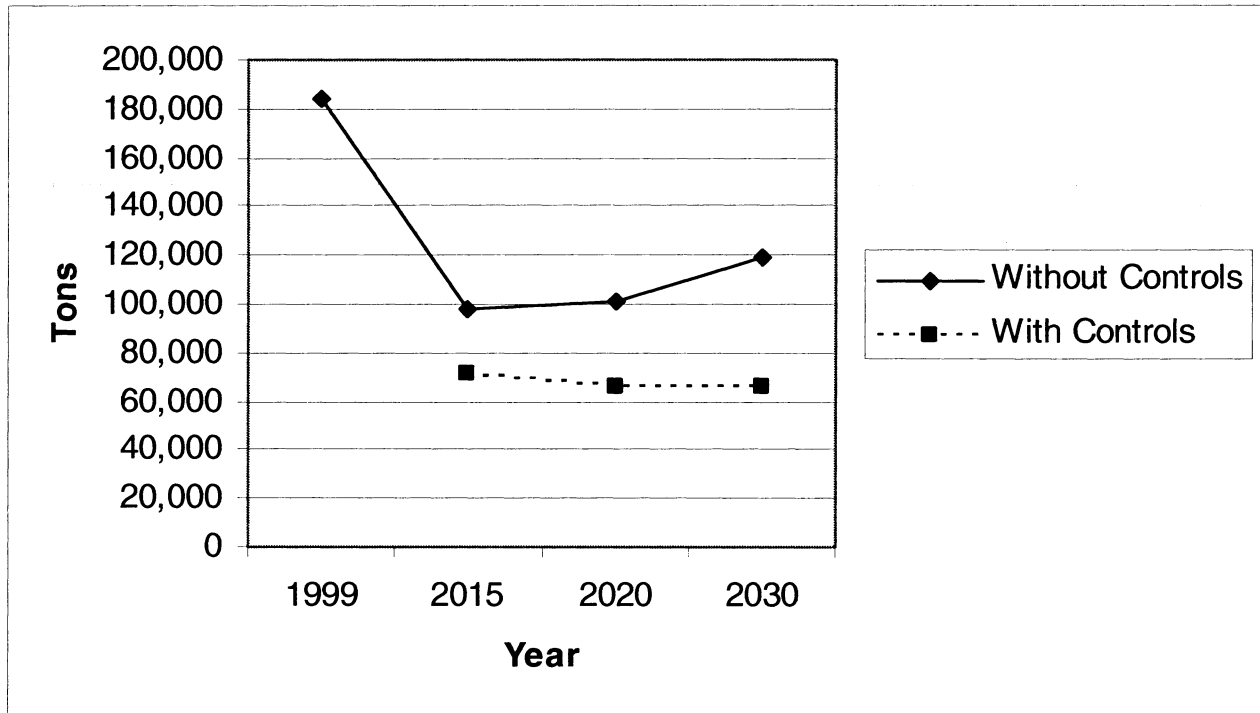


Figure IV.A-6. Benzene Emission Reductions from Portable Fuel Containers with All Controls in Place

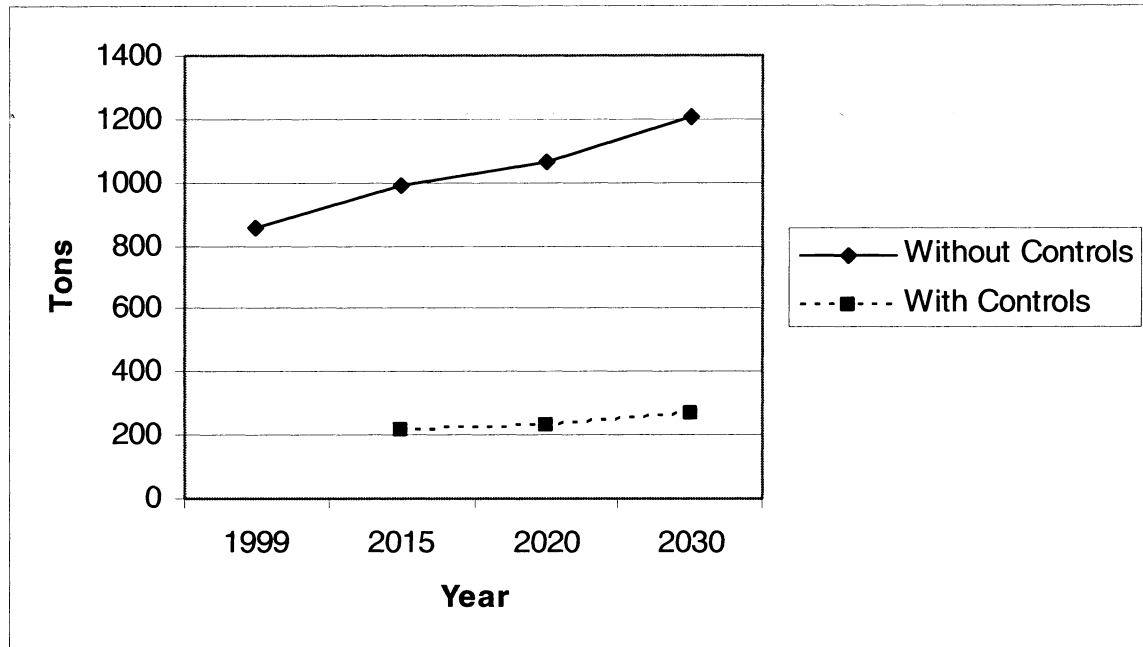


Figure IV.A-7. Total MSAT Emission Reductions from Gasoline Onroad Mobile

Sources with All Controls in Place

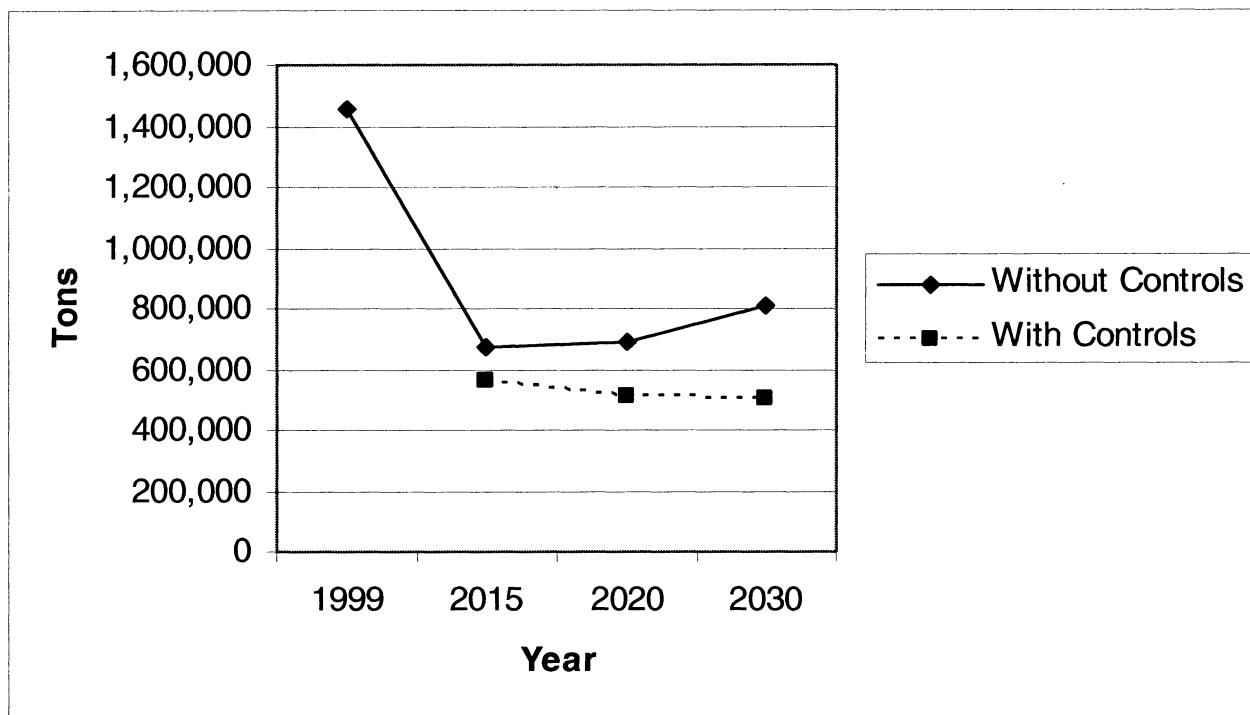


TABLE IV.A-3.—ESTIMATED REDUCTIONS IN EMISSIONS FROM INDIVIDUAL MSATS IN 2015, 2020 AND 2030, FROM GASOLINE VEHICLES, GASOLINE NONROAD ENGINES, AND PORTABLE FUEL CONTAINERS, RESULTING FROM THE CUMULATIVE IMPACTS OF THE CONTROLS IN THIS RULE ¹²⁷

MSAT	1999 (tons)	2015			2020			2030		
		Without rule (tons)	With rule (tons)	Reductions (tons)	Without rule (tons)	With rule (tons)	Reductions (tons)	Without rule (tons)	With rule (tons)	Reductions (tons)
1,3-Butadiene	31,234	14,771	13,259	1,512	15,037	12,535	2,501	17,054	12,834	4,220
2,2,4-Trimethylpentane ...	296,310	166,270	149,178	17,091	159,892	133,578	26,314	174,824	132,763	42,061
Acetaldehyde	27,800	21,223	18,154	3,069	22,156	17,011	5,145	25,754	17,213	8,541
Acrolein	3,835	1,650	1,457	193	1,665	1,347	317	1,889	1,360	529
Benzene	250,227	140,124	107,728	32,396	142,737	100,827	41,911	163,221	103,035	60,186
Ethyl Benzene	120,150	61,300	54,805	6,495	59,963	49,968	9,995	66,823	50,830	15,992
Formaldehyde	74,053	32,341	28,096	4,245	33,350	26,371	6,979	38,472	26,946	11,526
Hexane	106,464	57,852	52,042	5,810	54,673	46,926	7,747	59,152	48,029	11,124
MTBE	143,350	0	0	0	0	0	0	0	0	0
Propionaldehyde	4,142	2,195	1,965	231	2,249	1,869	380	2,565	1,932	633
Styrene	16,352	8,212	6,985	1,227	8,423	6,405	2,018	9,731	6,365	3,366
Toluene	729,908	390,688	347,363	43,325	380,420	312,542	67,878	420,534	310,654	109,880
Xylenes	487,768	252,993	228,561	24,432	245,180	206,913	38,267	270,775	208,839	61,936
Total MSATs	2,291,593	1,149,618	1,009,592	140,026	1,125,744	916,291	209,453	1,250,794	920,800	329,994

2. How Will VOC Emissions Be Reduced?

VOC emissions will be reduced by the hydrocarbon emission standards for

both light-duty vehicles and PFCs. As seen in the table and accompanying figure below Table IV.A-4 and Figure IV.A-8, annual VOC emission

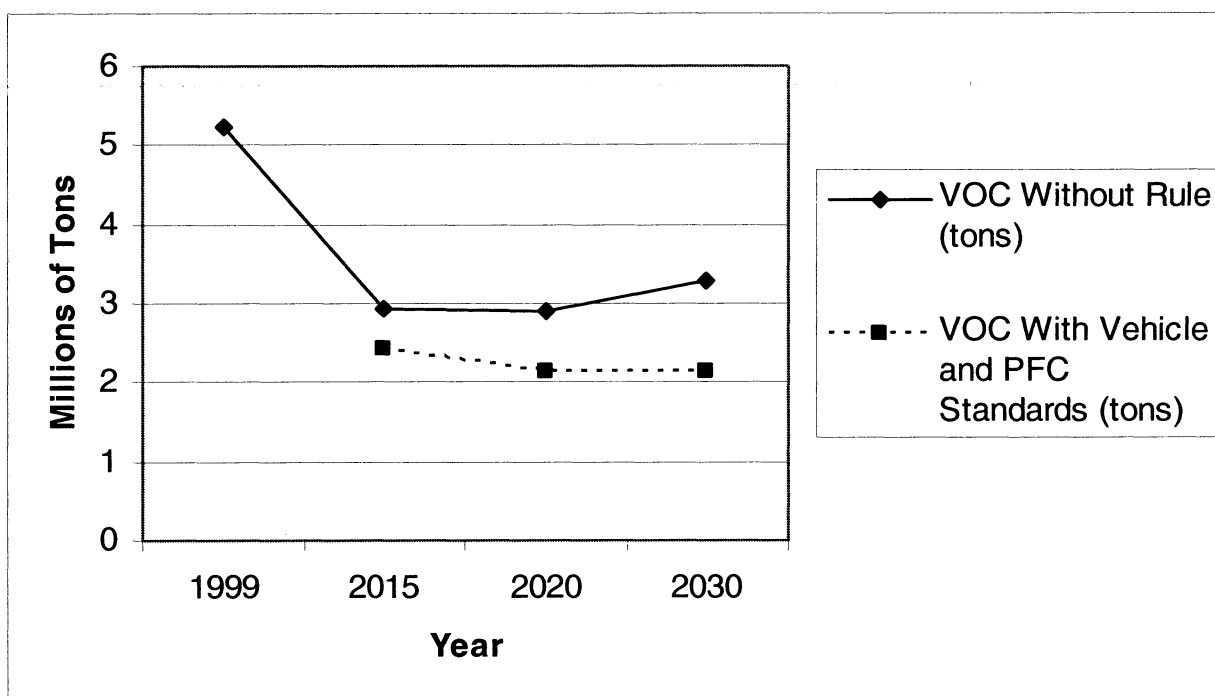
reductions from both of these sources will be 34% lower in 2030 because of this rule, and 59% lower than in 1999.

¹²⁷ Napthalene reductions from controls in this rule are not quantified, due to limitations in modeling tools.

TABLE IV.A-4. ESTIMATED REDUCTIONS IN VOC EMISSIONS FROM LIGHT-DUTY GASOLINE VEHICLES AND PFCs, 1999 TO 2030

	1999	2015	2020	2030
VOC Without Rule (tons)	5,224,921	2,944,491	2,892,134	3,281,752
VOC With Vehicle and PFC Standards (tons) .....	.....	2,420,860	2,146,476	2,153,735
VOC Reduction (tons) .....	.....	523,631	745,658	1,128,017

Figure IV.A-8. Estimated Reductions in VOC Emissions from Light-Duty Gasoline Vehicles and PFCs, 1999 to 2030



3. How Will PM Emissions Be Reduced?

EPA expects that the cold-temperature vehicle standards will reduce exhaust emissions of direct PM_{2.5} by over 19,000 tons in 2030 nationwide (see Table IV.A-5 below). Our analysis of the data from vehicles meeting Tier 2 emission standards indicate that PM emissions follow a monotonic relationship with

temperature, with lower temperatures corresponding to higher vehicle emissions. Additionally, the analysis shows the ratio of PM to total non-methane hydrocarbons (NMHC) to be independent of temperature.¹²⁸ Our testing indicates that strategies which reduce NMHC start emissions at cold temperatures also reduce direct PM emissions. Based on these findings,

direct PM emissions at cold temperatures were estimated using a constant PM to NMHC ratio. PM emission reductions were estimated by assuming that NMHC reductions will result in proportional reductions in PM. This assumption is supported by test data. For more detail, see Chapter 2.1 of the RIA.

TABLE IV.A-5. ESTIMATED NATIONAL REDUCTIONS IN DIRECT PM_{2.5} EXHAUST EMISSIONS FROM LIGHT-DUTY GASOLINE VEHICLES AND TRUCKS, 2015 TO 2030

	2015	2020	2030
PM _{2.5} Reductions from Vehicle Standards (tons)	7,068	11,646	19,421

¹²⁸ U.S. EPA. 2005. Cold-temperature exhaust particulate matter emissions. Memorandum from Chad Bailey to docket EPA-HQ-OAR-2005-0036.

B. Emission Impacts by Provision

1. Vehicle Controls

We are finalizing a hydrocarbon standard for gasoline passenger vehicles at cold temperatures. This standard will reduce VOC at temperatures below 75 °F, including air toxics such as benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein, and will also reduce emissions of direct and

secondary PM. We are also finalizing new evaporative emissions standards for Tier 2 vehicles starting in 2009. These new evaporative standards reflect the emissions levels already being achieved by manufacturers.

a. Volatile Organic Compounds (VOC)

Table IV.B-1 shows the VOC exhaust emission reductions from light-duty gasoline vehicles and trucks that will

result from the cold temperature hydrocarbon standard alone. The standards will reduce VOC emissions from these vehicles in 2030 by 31%. Overall VOC emissions from these vehicles will be reduced by 82% between 1999 and 2030 (including the effects of these standards as well as other standards in place, such as Tier 2).

TABLE IV.B.-1. ESTIMATED NATIONAL REDUCTIONS IN EXHAUST VOC EMISSIONS FROM LIGHT-DUTY GASOLINE VEHICLES AND TRUCKS, 1999 TO 2030.

	1999	2010	2015	2020	2030
VOC Without Rule (tons)	4,899,891	2,990,760	2,614,987	2,538,664	2,878,836
VOC With Proposed Vehicle Standards (tons)		2,839,012	2,293,703	2,009,301	1,996,074
VOC Reductions from Vehicle Standards (tons)		151,748	321,284	529,363	882,762
Percentage Reduction		5	12	21	31

b. Toxics

In 2030, we estimate that the vehicle standards will result in a 38% reduction

in total emissions of the MSATs and a 39% reduction in benzene emissions from light-duty vehicles and trucks (see Tables IV.B-1 and IV.B-2). Between

1999 and 2030, total MSATs from light-duty gasoline vehicles and trucks will be reduced by 64%, and benzene by 59%.

TABLE IV.B.-1. ESTIMATED NATIONAL REDUCTIONS IN EXHAUST MSAT EMISSIONS FROM LIGHT-DUTY GASOLINE VEHICLES AND TRUCKS, 1999 TO 2030

	1999	2010	2015	2020	2030
MSATs Without Rule (tons)	1,376,002	695,408	650,012	669,707	783,648
MSATs With Vehicle Standards (tons)		644,312	542,281	492,700	488,824
MSAT Reductions from Vehicle Standards (tons)		51,987	107,731	177,007	294,824
Percentage Reduction		7	17	26	38

TABLE IV.B.-2.—ESTIMATED NATIONAL REDUCTIONS IN BENZENE EXHAUST EMISSIONS FROM LIGHT-DUTY GASOLINE VEHICLES AND TRUCKS, 1999 TO 2030.

	1999	2010	2015	2020	2030
Benzene Without Rule (tons)	173,474	99,559	95,234	99,225	116,742
Benzene With Vehicle Standards (tons)		91,621	78,664	72,128	71,704
Benzene Reductions from Vehicle Standards (tons)		7,939	16,570	27,097	45,037
Percentage Reduction		8	17	27	39

c. PM_{2.5}

As discussed in Section IV.A.3, EPA expects that the cold-temperature vehicle standards will reduce exhaust emissions of direct PM_{2.5} by over 19,000 tons in 2030 nationwide (see Table IV.A-5).

2. Fuel Benzene Standard

The fuel benzene standard will reduce benzene exhaust and evaporative emissions from both on-road and nonroad mobile sources that are fueled

by gasoline. In addition, the fuel benzene standard will reduce evaporative emissions from gasoline distribution and PFCs. Impacts on 1,3-butadiene, formaldehyde, and acetaldehyde emissions are not significant, but are presented in Chapter 2 of the RIA. We do not expect the fuel benzene standard to have quantifiable impacts on any other air toxics, total VOCs, or direct PM.

Table IV.B-3 shows national estimates of total benzene emissions

from these source sectors with and without the fuel benzene standard in 2015. These estimates do not include effects of the vehicle or PFC standards (see section IV.A.1 for the combined effects of the controls). They also assume that the fuel program is fully phased in, which is a simplification of the actual phase-in. The fuel benzene standard will reduce total benzene emissions from on-road and nonroad gasoline mobile sources, PFCs, and gasoline distribution by 12% in 2015.

TABLE IV.B-3.—ESTIMATED REDUCTIONS IN BENZENE EMISSIONS FROM GASOLINE STANDARD BY SECTOR IN 2015

	Gasoline on-road mobile sources	Gasoline nonroad mobile sources	PFCs	Gasoline distribution	Total
Benzene Without Rule (tons)	97,789	41,343	992	2,445	142,569
Benzene With Gasoline Standard (tons)	86,875	35,825	619	1,635	124,954
Benzene Reductions from Gasoline Standard (tons)	10,914	5,518	373	810	17,615
Percentage Reduction	11	13	38	33	12

3. PFC Standards PFC standard. In 2015, VOC emissions from PFCs will be reduced by 61% because of reduced permeation, spillage, and evaporative losses.

a. VOC Table IV.B-4 shows the reductions in VOC emissions that we expect from the

TABLE IV.B-4.—ESTIMATED NATIONAL REDUCTIONS IN VOC EMISSIONS FROM PFCs, 1999 TO 2030

	1999	2010	2015	2020	2030
VOC Without Rule (tons)	325,030	316,756	329,504	353,470	402,916
VOC With PFC Standard (tons) .....	.....	256,175	127,157	137,175	216,294
VOC Reductions from PFC Standard (tons) .....	.....	60,580	202,347	216,294	245,255
Percentage Reduction .....	.....	19	61	61	61

b. Toxics estimate that benzene emissions from PFCs will be reduced by 68% (see Table IV.B-5) and, more broadly, air toxic emissions by 63% (see Table IV.B-6) in year 2015. These reductions do not include effects of the fuel benzene standard (see section IV.A-1 for the combined effects of the controls). Chapter 2 of the RIA provides details on the emission reductions of the other toxics.

The PFC standard will reduce emissions of benzene, toluene, xylenes, ethylbenzene, n-hexane, 2,2,4-trimethylpentane, and MTBE. We

TABLE IV.B-5.—ESTIMATED NATIONAL REDUCTIONS IN BENZENE EMISSIONS FROM PFCs, 1999 TO 2030

	1999	2010	2015	2020	2030
Benzene Without Rule (tons)	853	943	992	1063	1210
Benzene With PFC Standard (tons) .....	.....	743	320	345	396
Benzene Reductions from PFC Standard (tons) .....	.....	200	672	718	814
Percentage Reduction .....	.....	21	68	68	67

TABLE IV.B-6.—ESTIMATED NATIONAL REDUCTIONS IN TOTAL MSAT EMISSIONS FROM PFCs, 1999 TO 2030

	1999	2010	2015	2020	2030
MSATs Without Rule (tons)	37,167	26,189	27,355	29,338	33,430
MSATs With PFC Standard (tons) .....	.....	21,010	9,998	10,785	12,394
MSAT Reductions from PFC Standard (tons) .....	.....	5,179	17,357	18,553	21,036
Percentage Reduction .....	.....	20	63	63	63

C. What Are the Air Quality, Exposure, and Public Health Impacts of This Rule?

1. Mobile Source Air Toxics

The controls being finalized in this rule will reduce both evaporative and exhaust emissions from motor vehicles and nonroad equipment. They will also reduce emissions from PFCs and stationary source emissions associated with gasoline distribution. Therefore, they will reduce exposure to mobile source air toxics for the general population, and also for people near roadways, in vehicles, in homes with

attached garages, operating nonroad equipment, and living or working near sources of gasoline distribution emissions (such as bulk terminals, bulk plants, tankers, marine vessels, and service stations). Section III.B of this preamble and Chapter 3 of the RIA provide more details on these types of exposures.

We performed national-scale air quality, exposure, and risk modeling in order to quantitatively assess the impacts of the standards being finalized. The exposure modeling for the final rule accounted for the spatial variability of

outdoor concentrations of air toxics due to higher concentrations near roadways. This is a significant improvement over exposure modeling done for the proposal, and is discussed in more detail in Chapter 3 of the RIA. However, in addition to the limitations of the national-scale modeling tools (discussed in Chapter 3 of the RIA), this modeling did not account for the impacts of the recently proposed renewable fuel standard, as this standard was proposed subsequent to the development of inventories for air quality modeling. In addition, while the model includes the

0.62 vol% fuel benzene standard, it does not include the 1.3% maximum average.

The standards being finalized in this rule will reduce both the number of people above the 1 in 100,000 cancer risk level, and the average population cancer risk, by reducing exposures to mobile source air toxics. The number of people above the 1 in 100,000 cancer risk level due to exposure to all mobile source air toxics from all sources will decrease by over 11 million in 2020 and by almost 17 million in 2030. The number of people above the 1 in 100,000 cancer risk level from exposure to benzene from all sources will decrease by about 30 million in 2020 and 46 million in 2030. It should be noted that if it were possible to estimate

impacts of the standard on "background" concentrations¹²⁹, the estimated overall risk reductions would be even larger. The standards will also reduce the number of people with a respiratory hazard index (HI) greater than one by about 10 million in 2020, and 17 million in 2030. As previously discussed, a value of the HI greater than 1.0 can be best described as indicating that a potential may exist for adverse health effects.

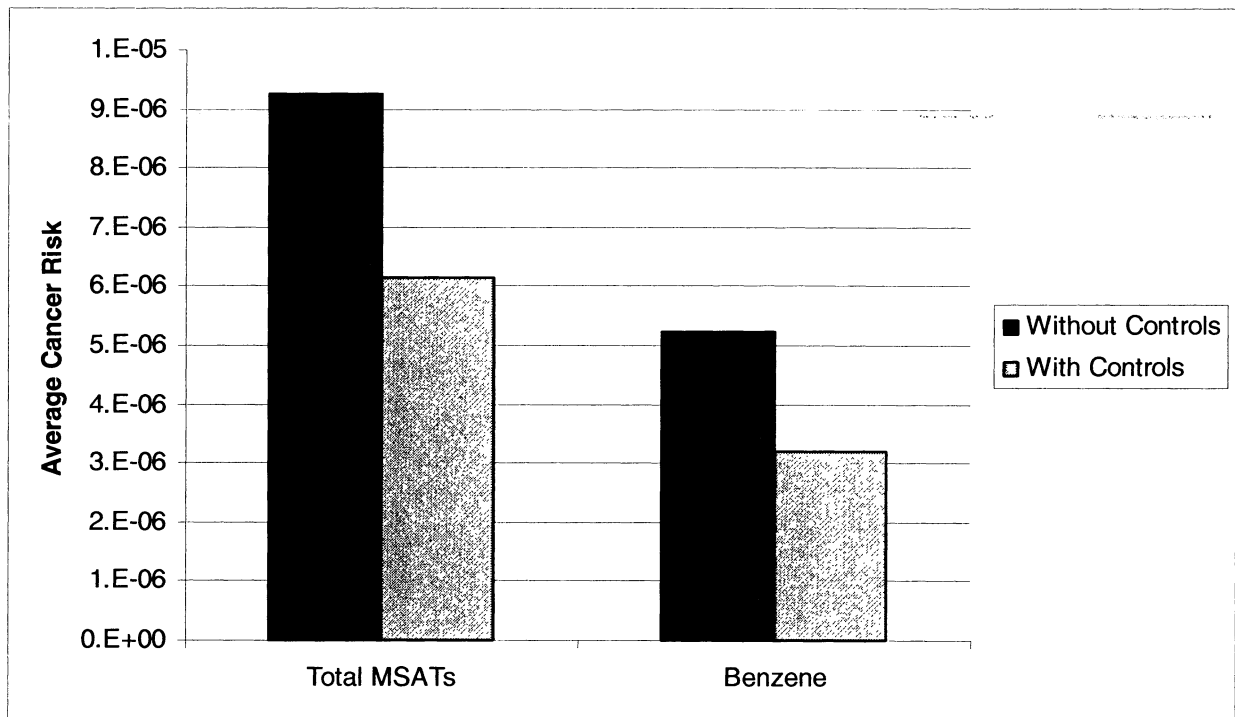
Figure IV.C-1 depicts the impact on the mobile source contribution to nationwide average population cancer risk from total MSATs and benzene in 2030. Nationwide, the cancer risk attributable to total MSATs will be reduced by 30%, and the risk from

mobile source benzene will be reduced by 37%. In 2030, the highway vehicle contribution to MSAT cancer risk will be reduced on average 36% across the U.S., and the highway vehicle contribution to benzene cancer risk will be reduced on average by 43% across the U.S. The methods and assumptions used to model the impact of the controls are described in more detail in Chapter 3 of the RIA.

Figure IV.C-2 depicts the impact on the mobile source contribution to nationwide average respiratory hazard index (HI) in 2030. Nationwide, the mobile source contribution to the respiratory hazard index will be reduced by 23%.

Figure IV.C-1. Impact of Controls Being Finalized in this Rule on the Mobile Source

Contribution to Nationwide Average Population Lifetime Cancer Risk in 2030.



¹²⁹ "Background represents the contribution to ambient levels of air toxics from sources further

away than 50 kilometers, as well as the contribution from uninventoried sources.

Figure IV.C-2. Impact of Controls Being Finalized in this Rule on the Mobile Source

Contribution to Nationwide Average Respiratory Hazard Index in 2030.

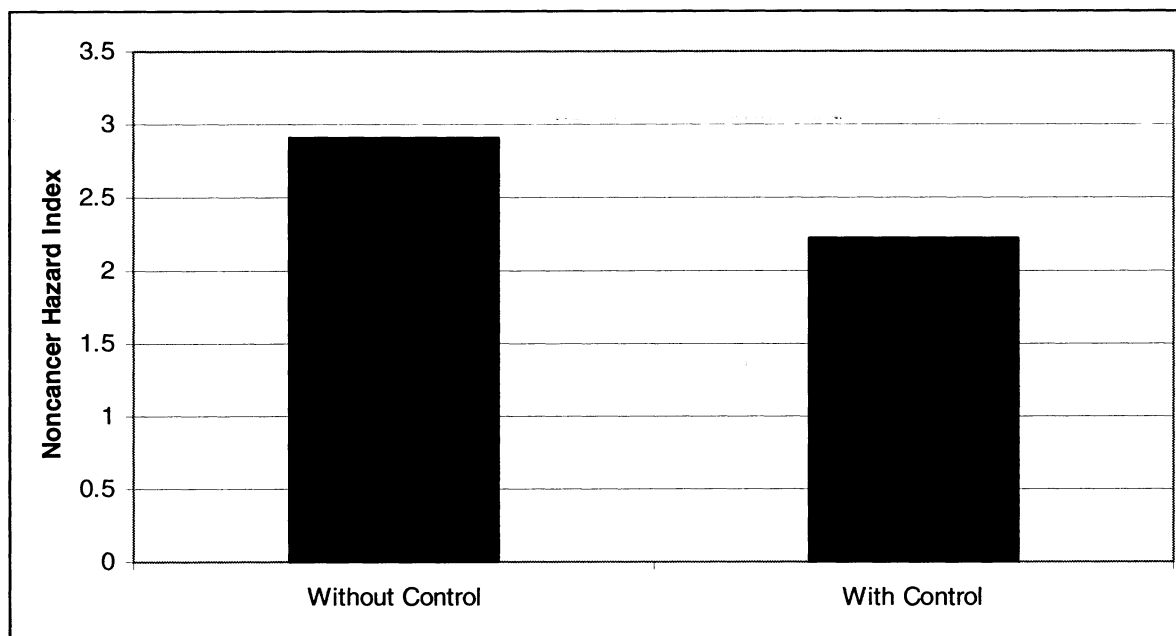


Table IV.C-1 summarizes the change in median and 95th percentile inhalation cancer risks from benzene and all MSATs attributable to all outdoor sources in 2015, 2020, and 2030, with the controls being finalized in this rule. The reductions in risk

would be larger if the modeling fully accounted for a number of factors, including exposure to benzene emissions from vehicles, equipment, and PFCs in attached garages and the impacts of the control program on “background” levels attributable to

transport. Reductions are significantly larger for individuals in the 95th percentile than in the 50th percentile. Thus, this rule is providing bigger benefits to individuals experiencing the highest levels of risk.

TABLE IV.C-1. CHANGE IN MEDIAN AND 95TH PERCENTILE INHALATION CANCER RISK FROM BENZENE AND ALL MSATs ATTRIBUTABLE TO OUTDOOR SOURCES IN 2015, 2020, AND 2030 WITH THE CONTROLS BEING FINALIZED IN THIS RULE

	2015		2020		2030	
	Median	95th	Median	95th	Median	95th
All MSATs:						
Without Controls	1.50×10^{-5}	4.75×10^{-5}	1.53×10^{-5}	4.93×10^{-5}	1.61×10^{-5}	5.28×10^{-5}
With Controls	1.41×10^{-5}	4.37×10^{-5}	1.40×10^{-5}	4.40×10^{-5}	1.42×10^{-5}	4.49×10^{-5}
Percent Change	6	8	8	11	12	15
Benzene:						
Without Controls	6.86×10^{-6}	1.82×10^{-5}	6.93×10^{-6}	1.86×10^{-5}	7.37×10^{-6}	2.06×10^{-5}
With Controls	6.17×10^{-6}	1.53×10^{-5}	6.02×10^{-6}	1.47×10^{-5}	6.06×10^{-6}	1.49×10^{-5}
Percent Change	10	16	13	21	18	28

2. Ozone

The vehicle and PFC standards will also reduce VOC emissions, which are a precursor to ozone. We have modeled the ozone impacts of the PFC standards. As described in more detail in Chapter 3.3 of the RIA, a metamodeling tool developed at EPA, the ozone response surface metamodel, was used to estimate the effects of the emission

reductions. The ozone response surface metamodel was created using multiple runs of the Comprehensive Air Quality Model with Extensions (CAMx). Base and control CAMx metamodeling was completed for two future years (2020, 2030) over a modeling domain that includes all or part of 37 Eastern U.S. states. For more information on the response surface metamodel, please see

the RIA for this final rule or the Air Quality Modeling Technical Support Document (TSD).

We have made estimates using the ozone response surface metamodel to illustrate the types of change in future ozone levels that we would expect to result from this rule, as described in Chapter 3 of the RIA. The PFC controls are projected to result in a very small

net improvement in future ozone, after weighting for population. Although the net future ozone improvement is small, some VOC-limited areas in the Eastern U.S. are projected to have non-negligible improvements in projected 8-hour ozone design values due to the PFC controls. We view these improvements as useful in meeting the 8-hour ozone NAAQS. These net ozone improvements are in addition to reductions in levels of benzene, a toxic ozone precursor, due to the PFC controls.

3. PM

As described in section IV.A, the vehicle standards will reduce emissions of direct PM. The PM health benefits that would be associated with these reductions in PM emissions and exposure are discussed in section VIII.E of this preamble. The vehicle and PFC standards will also reduce VOC emissions, which contribute to the secondary formation of PM. In this rule we have not quantified the impact of the VOC emission reductions on ambient PM or associated health effects.

D. What Other Mobile Source Emissions Control Programs Reduce MSATs?

As described in section IV.A, existing mobile source control programs in combination with this rule will reduce MSAT emissions (not including diesel PM) by 45% between 1999 and 2030. The existing mobile source programs include controls on fuels, highway vehicles, and nonroad engines and equipment. These programs are also reducing hydrocarbons and PM more generally, as well as oxides of nitrogen. The sections immediately below provide general descriptions of these programs that will be providing MSAT emission reductions, as well as voluntary programs such as the National Clean Diesel Campaign and Best Workplaces for Commuters. We also discuss some programs that are currently being developed. A more detailed description of mobile source programs is provided in Chapter 2 of the RIA.

1. Fuels Programs

As described in section VI of this preamble, this rule would supersede the 2001 MSAT rule and certain provisions of the reformulated gasoline program and anti-dumping programs. These programs are described in Chapter 2 of the RIA.

a. Gasoline Sulfur

EPA's gasoline sulfur program¹³⁰ requires, beginning in 2006, that sulfur

levels in gasoline could be no higher than 80 ppm as a per-gallon cap, and must average 30 ppm annually. When fully effective, gasoline will have 90 percent less sulfur than before the program. Reduced sulfur levels are necessary to ensure that vehicle emission control systems are not impaired. These systems effectively reduce non-methane organic gas (NMOG) emissions, of which some are air toxics, as well as emissions of NO_x. With lower sulfur levels, emission control technologies can work longer and more efficiently. Both new and older vehicles benefit from reduced gasoline sulfur levels.

b. Gasoline Volatility

A fuel's volatility defines its evaporation characteristics. A gasoline's volatility is commonly referred to as its Reid vapor pressure, or RVP. Gasoline summertime RVP ranges from about 6–9 psi, and wintertime RVP ranges from about 9–14 psi, when additional volatility is required for starting in cold temperatures. Gasoline vapors contain a subset of the liquid gasoline components, and thus can contain toxics compounds such as benzene. Since 1989, EPA has controlled summertime gasoline RVP primarily as a VOC and ozone precursor control, resulting in additional toxics pollutant reductions.

c. Diesel Fuel

In early 2001, EPA issued rules requiring that diesel fuel for use in highway vehicles contain no more than 15 ppm sulfur beginning June 1, 2006.¹³¹ This program contains averaging, banking and trading provisions during the transition to the 15 ppm level, as well as other compliance flexibilities. In June 2004, EPA issued rules governing the sulfur content of diesel fuel used in nonroad diesel engines.¹³² In the nonroad rule, sulfur levels are limited to a maximum of 500 ppm sulfur beginning in 2007 (current levels are approximately 3000 ppm). In 2010, nonroad diesel sulfur levels must not exceed 15 ppm.

EPA's diesel fuel requirements are part of a comprehensive program to combine engine and fuel controls to achieve the greatest emission reductions. The diesel fuel provisions enable the use of advanced emission-control technologies on diesel vehicles and engines. The diesel fuel requirements will also provide immediate public health benefits by

reducing PM emissions from current diesel vehicles and engines.

d. Phase-Out of Lead in Gasoline

One of the first programs to control toxic emissions from motor vehicles was the removal of lead from gasoline. Beginning in the mid-1970s, unleaded gasoline was phased in to replace leaded gasoline. The phase-out of leaded gasoline was completed January 1, 1996, when lead was banned from motor vehicle gasoline. The removal of lead from gasoline has essentially eliminated on-highway mobile source emissions of this highly toxic substance.

2. Highway Vehicle and Engine Programs

The 1990 Clean Air Act Amendments set specific emission standards for hydrocarbons and for PM. Air toxics are present in both of these pollutant categories. As vehicle manufacturers develop technologies to comply with the hydrocarbon (HC) and particulate standards (e.g., more efficient catalytic converters), air toxics are reduced as well. Since 1990, we have developed a number of programs to address exhaust and evaporative hydrocarbon emissions and PM emissions.

Two of our recent initiatives to control emissions from motor vehicles and their fuels are the Tier 2 control program for light-duty vehicles and the 2007 heavy-duty engine rule. Together these two initiatives define a set of comprehensive standards for light-duty and heavy-duty motor vehicles and their fuels. In both of these initiatives, we treat vehicles and fuels as a system. The Tier 2 control program establishes stringent tailpipe and evaporative emission standards for light-duty vehicles and a reduction in sulfur levels in gasoline fuel beginning in 2004.¹³³ The 2007 heavy-duty engine rule establishes stringent exhaust emission standards for new heavy-duty engines and vehicles for the 2007 model year as well as reductions in diesel fuel sulfur levels starting in 2006.¹³⁴ Both of these programs will provide substantial emissions reductions through the application of advanced technologies. We expect 90% reductions in PM from new diesel engines compared to engines under current standards.

Some of the key earlier programs controlling highway vehicle and engine emissions are the Tier 1 and NLEV standards for light-duty vehicles and trucks; enhanced evaporative emissions standards; the supplemental federal test procedures (SFTP); urban bus standards;

¹³¹ 66 FR 5002, January 18, 2001. See <http://www.epa.gov/otaq/highway-diesel/index.htm>.

¹³² 69 FR 38958, June 29, 2004.

¹³³ 65 FR 6697, February 10, 2000.

¹³⁴ 66 FR 5001, January 18, 2001.

¹³⁰ 65 FR 6822 (February 10, 2000).

and heavy-duty diesel and gasoline standards for the 2004/2005 time frame.

3. Nonroad Engine Programs

There are various categories of nonroad engines, including land-based diesel engines (e.g., farm and construction equipment), small land-based spark-ignition (SI) engines (e.g., lawn and garden equipment, string trimmers), large land-based SI engines (e.g., forklifts, airport ground service equipment), marine engines (including diesel and SI, propulsion and auxiliary, commercial and recreational), locomotives, aircraft, and recreational vehicles (off-road motorcycles, "all terrain" vehicles and snowmobiles). Chapter 2 of the RIA provides more information about these programs.

As with highway vehicles, the VOC standards we have established for nonroad engines will also significantly reduce VOC-based toxics from nonroad engines. In addition, the standards for diesel engines (in combination with the stringent sulfur controls on nonroad diesel fuel) will significantly reduce diesel PM and exhaust organic gases, which are mobile source air toxics.

In addition to the engine-based emission control programs described below, fuel controls will also reduce emissions of air toxics from nonroad engines. For example, restrictions on gasoline formulation (the removal of lead, limits on gasoline volatility and RFG) are projected to reduce nonroad MSAT emissions because most gasoline-fueled nonroad vehicles are fueled with the same gasoline used in on-highway vehicles. An exception to this is lead in aviation gasoline. Aviation gasoline, used in general (as opposed to commercial) aviation, is a high octane fuel used in a relatively small number of aircraft (those with piston engines). Such aircraft are generally used for personal transportation, sightseeing, crop dusting, and similar activities.

4. Voluntary Programs

In addition to the fuel and engine control programs described above, we are actively promoting several voluntary programs to reduce emissions from mobile sources, such as the National Clean Diesel Campaign, anti-idling measures, and Best Workplaces for CommutersSM. While the stringent emissions standards described above apply to new highway and nonroad diesel engines, it is also important to reduce emissions from the existing fleet of about 11 million diesel engines. EPA has launched a comprehensive initiative called the National Clean Diesel Campaign, one component of which is to promote the reduction of emissions in

the existing fleet of engines through a variety of cost-effective and innovative strategies. The goal of the Campaign is to reduce emissions from the 11 million existing engines by 2014. Emission reduction strategies include switching to cleaner fuels, retrofitting engines through the addition of emission control devices and engine replacement. For example, installing a diesel particulate filter achieves diesel particulate matter reductions of approximately 90 percent (when combined with the use of ultra low sulfur diesel fuel). The Energy Policy Act of 2005 includes grant authorizations and other incentives to help facilitate voluntary clean diesel actions nationwide.

The National Clean Diesel Campaign is focused on leveraging local, state, and federal resources to retrofit or replace diesel engines, adopt best practices and track and report results. The Campaign targets five key sectors: school buses, ports, construction, freight and agriculture. Almost 300 clean diesel projects have been initiated through the Campaign. These projects will reduce more than 20,000 PM lifetime tons. PM and NO_x reductions from these programs will provide nearly \$5 billion in health benefits.

Reducing vehicle idling provides important environmental benefits. As a part of their daily routine, truck drivers often keep their vehicles running at idle during stops to provide power, heat and air conditioning. EPA's SmartWaySM Transport Partnership is helping the freight industry to adopt innovative idle reduction technologies and to take advantage of proven systems that provide drivers with basic necessities without idling the main engine. To date, there are 80 mobile and stationary idle-reduction projects throughout the country. Emission reductions, on an annual basis, from these programs are in excess of 157,000 tons of CO₂, 2,000 tons of NO_x and 60 tons of PM; over 14 million gallons of fuel are being saved annually. The SmartWay Transport Partnership also works with the freight industry by promoting a wide range of new technologies such as advanced aerodynamics, single-wide tires, weight reduction, speed control and intermodal shipping.

Daily commuting represents another significant source of emissions from motor vehicles. EPA's Best Workplaces for CommutersSM program is working with employers across the country to reverse the trend of longer, single-occupancy vehicle commuting. OTAQ recognizes employers that have met the National Standard of Excellence for Commuter Benefits by adding them to the List of Best Workplaces for

Commuters. These companies offer superior commuter benefits such as transit subsidies for rail, bus, and vanpools and promote flexi-place and telework. Emergency Ride Home programs provide a safety net for participants. More than 1,600 employers representing 3.5 million U.S. workers have been designated Best Workplaces for Commuters.

Much of the growth in the Best Workplaces for Commuters program has been through metro area-wide campaigns. Since 2002, EPA has worked with coalitions in over 14 major metropolitan areas to increase the penetration of commuter benefits in the marketplace and the visibility of the companies that have received this distinguished designation. Another significant path by which the program has grown is through Commuter Districts including corporate and industrial business parks, shopping malls, business improvement districts and downtown commercial areas. To date EPA has granted the Best Workplaces for Commuters "District" designation to over twenty locations across the country including sites in downtown Denver, Houston, Minneapolis, Tampa and Boulder.

5. Additional Programs Under Development That Will Reduce MSATs

a. On-Board Diagnostics for Heavy-Duty Vehicles Over 14,000 Pounds

The Agency has proposed on-board diagnostics (OBD) requirements for heavy-duty vehicles over 14,000 pounds.¹³⁵ In general, OBD systems monitor the operation of key emissions controls to detect any failure that would lead to emissions above the standards during the life of the vehicle. Given the nature of the heavy-duty trucking industry, 50-state harmonization of emissions requirement is an important consideration. Initially, the Agency signed a Memorandum of Agreement in 2004 with the California Air Resources Board which expressed both agencies' interest in working towards a single, nationwide program for heavy-duty OBD. Since that time, California has established their heavy-duty OBD program, which will begin implementation in 2010. EPA's program will also begin in 2010. These requirements will help ensure that the emission reductions we projected in the 2007 rulemaking for heavy-duty engines occur in-use.

¹³⁵ <http://epa.gov/obd/regtech/heavy.htm>.

b. Standards for Small Nonroad Spark-Ignition Engines

We are developing a proposal for small nonroad spark-ignition engines, those typically used in lawn and garden equipment and in spark-ignition marine engines. This proposal is being developed in response to Section 428 of the Omnibus Appropriations Bill for 2004, which requires EPA to propose regulations under Clean Air Act section 213 for new nonroad spark-ignition engines under 50 horsepower. We plan to propose standards that would further reduce engine and equipment emissions for these nonroad categories. We anticipate that any new standards would provide significant additional reductions in exhaust and evaporative HC (and VOC-based toxics) emissions.

c. Standards for Locomotive and Marine Diesel Engines

We are planning to propose more stringent standards for large diesel engines used in locomotive and marine applications, as discussed in a recent Advance Notice of Proposed Rulemaking.¹³⁶ New standards for marine diesel engines would apply to engines less than 30 liters per cylinder in displacement (all engines except for Category 3). We are considering standards modeled after our Tier 4 nonroad diesel engine program, which achieve substantial reductions in PM, HC, and NO_x emissions. These standards would be based on the use of high efficiency catalyst aftertreatment and would also require fuel sulfur control.

E. How Do These Mobile Source Programs Satisfy the Requirements of Clean Air Act Section 202(l)?

The benzene and hydrocarbon standards in this action will reduce benzene, 1,3-butadiene, formaldehyde, acrolein, polycyclic organic matter, and naphthalene, as well as many other hydrocarbon compounds that are emitted by motor vehicles, including those that are discussed in more detail in Chapter 1 of the RIA. The emission reductions expected from today's controls are set out in section IV.A and B of this preamble and Chapter 2 of the RIA.

EPA believes that the emission reductions from the standards finalized today for motor vehicles and their fuels, combined with the standards currently in place, represent the maximum achievable reductions of emissions from motor vehicles through the application of technology that will be available, considering costs and the other factors

listed in section 202(l)(2). This conclusion applies whether one considers just the compounds listed in Table 1.1–1 of the RIA, or consider all of the compounds on the Master List of emissions, given the breadth of EPA's current control programs and the broad groups of emissions that many of the control technologies reduce. For example, EPA has already taken significant steps to reduce diesel emissions from motor vehicles (as well as other mobile sources). As explained above, we have adopted stringent standards for on-highway diesel trucks and buses and these standards control the air toxics emitted by these motor vehicles to the extent feasible.

Emissions from motor vehicles can be chemically categorized as hydrocarbons, trace elements (including metals) and a few additional compounds containing carbon, nitrogen and/or halogens (e.g., chlorine). For the hydrocarbons, which are the vast majority of these compounds, we believe that with the controls finalized today, we will control the emissions of these compounds from motor vehicles to the maximum amount currently feasible or currently identifiable with available information. Section V of this preamble provides more details about why the standards represent maximum achievable reduction of hydrocarbons from motor vehicles. Motor vehicle controls do not reduce individual hydrocarbons selectively; instead, the maximum emission reductions are achieved by controls on hydrocarbons as a group. There are fuel controls that could selectively reduce individual air toxics (e.g., formaldehyde, acetaldehyde, 1,3-butadiene), as well as controls that reduce hydrocarbons more generally. Section VI of this preamble describes why the standards we are finalizing today represent the maximum emission reductions achievable through fuel controls, after considering the factors enumerated in section 202(l)(2) of the Clean Air Act.

Motor vehicle emissions also contain trace elements, including metals, which originate primarily from engine wear and impurities in engine oil and gasoline or diesel fuel. EPA does not have authority to regulate engine oil, and there are no feasible motor vehicle controls to directly prevent engine wear. Nevertheless, oil consumption and engine wear have decreased over the years, decreasing emission of metals from these sources. Metals associated with particulate matter will be captured in emission control systems employing a particulate matter trap, such as will be used in heavy-duty vehicles meeting the 2007 standards. We believe that

currently, particulate matter traps, in combination with engine-out control, represent the maximum feasible reduction of both motor vehicle particulate matter and toxic metals present as a component of the particulate matter.

The mobile source contribution to the national inventory for metal compounds is generally small. In fact, the emission rate for most metals from motor vehicles is small enough that quantitative measurement requires state-of-the-art analytical techniques that are only recently being applied to this source category. We have efforts underway to gather information regarding trace metal emissions, including mercury emissions, from motor vehicles (see Chapter 1 of the RIA for more details).

A few metals and other elements are used as fuel additives. These additives are designed to reduce the emission of regulated pollutants either in combination with or without an emission control device (e.g., a passive particulate matter trap). Clean Air Act section 211 (a) and (b) provide EPA with various authorities to require the registration of fuel additives by their manufacturers before their introduction into commerce. Registration involves certain data requirements that enable EPA to identify products whose emissions may pose an unreasonable risk to public health. In addition, this section provides EPA with authority to require health effects testing to fill any gaps in the data that would prevent a determination regarding the potential for risk to the public. It is under the section 211 registration program that EPA is currently generating the information needed to update an assessment of the potential human health risks related to having manganese in the national fuel supply. Clean Air Act section 211(c) provides the primary mechanism by which EPA would take actions necessary to minimize exposure to emissions of metals or other additives to diesel and gasoline.

Existing regulations limit sulfur in gasoline and diesel fuel to the maximum amount feasible and will reduce emissions of all sulfur-containing compounds (e.g., hydrogen sulfide, carbon disulfide) to the greatest degree achievable.^{137 138 139} For the remaining compounds (e.g., chlorinated

¹³⁷ 65 FR 6697, February 10, 2000.

¹³⁸ 66 FR 5001, January 18, 2001.

¹³⁹ 69 FR 38958, June 29, 2004 (standards for non-road diesel engines and fuels). Although non-road vehicles are not "motor vehicles," and so are not subject to section 202(l)(2), EPA nevertheless has adopted standards resulting in the greatest feasible reductions of mobile source air toxics from these engines.

¹³⁶ 69 FR 39276, June 29, 2004.

compounds), we currently have very little information regarding emission rates and conditions that impact emissions. This information would be necessary in order to evaluate potential controls under section 202(l). Emissions of hydrocarbons containing chlorine (e.g., dioxins/furans) would likely be reduced with control measures that reduce total hydrocarbons, just as these emissions were reduced with the use of catalytic controls that lowered exhaust hydrocarbons.

V. New Light-Duty Vehicle Standards

A. Introduction

The program we are establishing for vehicles will achieve the same significant toxics reductions that we projected for the proposed rule (see generally 71 FR 15845–15848). The program is very similar to that proposed except for a few minor changes made in response to comments we received. These changes will improve the implementation of the program without significantly changing the program's overall emission reductions and environmental benefits. As described in this section, we are adopting stringent new nonmethane hydrocarbon standards for vehicles to reduce hydrocarbon (HC) emissions during vehicle cold temperature operation. As discussed in the proposal, the current HC emissions standards are measured within a range of specified warm temperatures, and the test procedure does not include cold temperatures. Data indicate that cold HC emissions currently are very high for many vehicles compared to emissions at normal test temperatures. The new cold temperature standards and program requirements will be phased in starting in 2010. When fully phased in, the new standards will further reduce overall vehicle HC emissions by about 31%, or by about 883,000 tons in 2030.

By reducing overall HC emissions from vehicles, we will be significantly reducing several gaseous toxics including benzene, formaldehyde, 1,3-butadiene, and acetaldehyde. We also project that the cold temperature standard will provide concurrent reductions in direct PM emissions from vehicles, since the strategies manufacturers are expected to employ to reduce cold HC will reduce PM as well. Although Clean Air Act section 202(l) deals with control of air toxics,

and not criteria pollutants like PM, this co-benefit of cold temperature control is significant.

We are finalizing the new cold temperature standards and implementation schedule essentially as proposed. We are also adopting several other related provisions and requirements largely as proposed. Many of these provisions will help the manufacturers smoothly transition to the new standards in the shortest lead time possible. They include corporate average emissions standards, emissions credits, options for alternative phase-in schedules, and special provisions for small businesses. The program also includes certification and compliance provisions.

We are also adopting new evaporative emissions standards, beginning in model year 2009. The new standards are essentially the same as those contained in the California LEVII program. Manufacturers have been selling 50-state evaporative systems that meet both the Tier 2 and LEVII requirements. Today's final rule will ensure that industry continues this practice.

Sections V.B. and V.C. provide the details of the new cold temperature and evaporative emissions standards, respectively, and briefly discuss some of the comments we received on the proposed vehicles program. We have seriously considered all of the input from stakeholders in developing the final vehicles program and believe that the final rule appropriately addresses the concerns of all stakeholders. We provide a full discussion of the comments we received on vehicles in Chapter 3 of the Summary and Analysis of Comments for this rule.

B. What Cold Temperature Requirements Are We Adopting?

1. Why Are We Adopting a New Cold Temperature NMHC Standard?

As emissions standards have become more stringent, manufacturers have concentrated primarily on controlling emissions performance just after the start of the engine in order to further reduce emissions. To comply with stringent hydrocarbon emission standards at 75 °F, manufacturers developed new emission control strategies and practices that resulted in significant emissions reductions at that start temperature. We expected that proportional reductions in hydrocarbon

emissions would occur at other colder start temperatures as a result of the more stringent standards. We believe that there is no engineering reason why proportional control should not be occurring on a widespread basis.

In some cases, certification data for recent model year light-duty vehicles indicate that individual vehicles did demonstrate proportional improvements in hydrocarbon emission results at 20 °F relative to their 75 °F results, confirming our belief that proportional control is feasible and indeed is practiced at least occasionally. One manufacturer's certification results reflected proportional improvements across almost its entire vehicle lines, further supporting that proportional control is feasible. However, for most vehicles, certification reports show a sharp rise in hydrocarbon¹⁴⁰ emissions at 20 °F when compared to the reported 75 °F hydrocarbon emission levels. Any rise in hydrocarbon emissions, specifically nonmethane hydrocarbons (NMHC), will result in proportional rise in VOC-based air toxics.¹⁴¹ While some increase in NMHC emissions can be expected simply due to combustion limitations of gasoline engines at colder temperatures, the reported levels of hydrocarbon emissions seem to indicate a significantly diminished use of hydrocarbon emissions controls occurring at colder temperatures. Thus, although all vehicle manufacturers have been highly successful at reducing emissions at the test start temperature range, in general, they do not appear to be capitalizing on NMHC emission control strategies and technologies at lower temperatures. This is likely because compliance with hydrocarbon standards is not required at 20 degree F temperatures. (see 71 FR at 15845.) Today's rule remedies this by requiring such compliance.

2. What Are the New NMHC Exhaust Emissions Standards?

We are finalizing a set of standards that will achieve proportional NMHC control from the 75 °F Tier 2 standards to the 20 °F test point. We expect that by fully utilizing available Tier 2 hardware and software control strategies, manufacturers will be able to achieve this standard without major changes to Tier 2 vehicle designs or the use of additional technology. Table V.B–1 contains the final standards.

¹⁴⁰ Most certification 20 °F hydrocarbon levels are reported as total hydrocarbon (THC), but NMHC accounts for approximately 95% of THC as seen in

results with both THC and NMHC levels reported. This relationship also is confirmed in EPA test programs supporting this rulemaking.

¹⁴¹ "VOC/PM Cold Temperature Characterization and Interior Climate Control Emissions/Fuel Economy Impact," Volume I and II, October 2005.

TABLE V.B-1.—20 °F FTP EXHAUST EMISSION STANDARDS

Vehicle GVWR and category	NMHC sales-weighted fleet average standard (grams/mile)
≤6000 lbs: Light-duty vehicles (LDV) & Light light-duty trucks (LLDT)	0.3
>6000 lbs: Heavy light-duty trucks (HLDT) up to 8,500 lbs & Medium-duty passenger vehicles (MDPV) up to 10,000 lbs	0.5

As shown in the table, we are finalizing, as proposed, two separate sales-weighted fleet average NMHC standards: 0.3 grams/mile for vehicles at or below 6,000 pounds (lbs) GVWR and 0.5 grams/mile for vehicles over 6,000 lbs, including MDPVs.¹⁴² NMHC emissions will be measured during the Cold Federal Test Procedure (FTP) test, which already requires hydrocarbon measurement.¹⁴³ The new standard does not require additional certification testing beyond what is required today with “worst case” model selection of a durability test group.¹⁴⁴

The separate fleet average standards we are finalizing account for challenges related to vehicle weight. We examined certification data from Tier 2 and interim non-Tier 2 vehicles (i.e., vehicles not yet phased into the final Tier 2 program, but meeting interim standards established by Tier 2), and saw a general trend of increased hydrocarbon levels with heavier GVWR vehicles. Some comments suggested that the standard for HLDT/MDPVs should be the same standard as applies to LDVs or contain a second future phase that reduces emissions to those levels. At this time, we continue to believe that heavier vehicles have application-specific design limitations. Heavier vehicles generally produce higher emissions for several reasons. First, added weight requires additional work to accelerate the vehicle mass, generally resulting in higher emissions, particularly soon after engine start-up. Second, the design of these emission control systems may incorporate designs for specific duty cycles (i.e., trailer

towing) that can negatively affect emissions, particularly during 20° F cold starts. For example, since the catalyst may be located further away from the engine for protection from high exhaust temperatures during design-specific duty cycles, warm-up of the catalyst is typically delayed, especially at colder temperatures. Therefore, we believe the 0.3 g/mile fleet average standard for vehicles below 6,000 lbs GVWR is not technically feasible at this time for heavier vehicles. We are thus finalizing a 0.5 g/mile standard for vehicles over 6000 lbs GVWR, including both HLDTs (6000 lbs to 8500 lbs) and MDPVs.

We are finalizing the sales-weighted fleet average approach as proposed, as the way to achieve the greatest degree of emission control for Tier 2 vehicles. At the same time, this approach allows manufacturers sufficient lead time and flexibility to certify different vehicle groups to different levels, thus lowering the costs of the program. A fleet average provides manufacturers with flexibility to balance challenging vehicle families with ones that more easily achieve the standards. We believe this approach is appropriate because the base Tier 2 program is also based on emissions averaging, and will result in a mix of emissions control strategies across the fleet that have varying cold temperature capabilities. While the Tier 2 program continues to phase in, manufacturers are concurrently developing emissions control packages. The capabilities of each Tier 2 package will not be fully understood until manufacturers are able to evaluate the potential of the individual designs to control cold temperature emissions.

We received several comments from state and environmental groups supporting the new cold temperature standards. Manufacturers indicated their support of the Agency’s initiative to seek reductions in MSATs, and one manufacturer commented that cold temperature hydrocarbon control is both effective and logical. Manufacturers commented that the new standards would be very challenging, but that the flexibilities incorporated into the final rule will significantly help manufacturers achieve the new

standards. One manufacturer with a product line limited to vehicles below 6,000 lbs GVWR suggested that the 0.3 g/mile standard was too stringent and unreasonable based on an assessment of their current vehicle emission levels. The manufacturer’s comments did not provide data or further technical analysis to substantiate this claim. We know of no engineering basis for the standards not being technically achievable. Moreover, there are about nine other manufacturers with similar product lines exclusively below 6,000 lbs GVWR, and they did not provide similar comments. We continue to believe that with careful examination of existing emission control opportunities at colder temperatures on Tier 2 compliant vehicles, especially given the lead time provided, manufacturers will identify strategies to comply with the new standards across their product lines.

We are establishing a Family Emissions Limit (FEL) structure in which manufacturers will determine individual FELs for each group of vehicles certified. These FELs are the standard for each individual group, and are averaged on a sales-weighted basis to demonstrate overall compliance with the fleet average standards. We are using the FEL-based approach for the new cold temperature NMHC standards because we believe it results in the same level of environmental benefit but adds flexibility and leads to cost-effective compliance strategies. The FEL approach is discussed further in section V.B.4 below.

We are applying the new cold temperature NMHC standards to light-duty gasoline-fueled vehicles. However, diesel vehicles, alternative-fueled vehicles, and heavy-duty vehicles will not be subject to these standards, since we lack data on which to base standards. Section V.B.6.a provides a detailed discussion of applicability and comments received.

3. Feasibility of the Cold Temperature NMHC Standards

We believe the new standards will be challenging but are attainable and provide the greatest emission reductions using technology that will be available.

¹⁴² Tier 2 created the medium-duty passenger vehicle (MDPV) category to include larger complete passenger vehicles, such as SUVs and vans, with a GVWR of 8,501–10,000 pounds GVWR. Large pickups above 8,500 pounds are not included in the MDPV category but are included in the heavy-duty vehicle category.

¹⁴³ 40 CFR Subpart C, § 86.244–94 requires the measurement of all pollutants measured over the FTP except NO_x.

¹⁴⁴ The existing cold FTP test procedures are specified in 40 CFR Subpart C. In the final rule for fuel economy labeling, (71 FR 77872, December 27, 2006), EPA revised the cold FTP test protocol to require manufacturers to run the heater and/or defroster while conducting the cold FTP test. This had previously been an optional provision. We do not believe this requirement will have a significant impact on emissions.

The feasibility assessment described below is based on our analysis of the standard's stringency given current emission levels at certification (considering deterioration, compliance margin, and vehicle weight), available emission control techniques, and our own feasibility testing. In addition, sections V.B.3–6 describe the lead time and flexibility within the program structure, which also contribute to the achievability of the standards. There are a number of technologies discussed below that can be utilized to achieve these standards. We expect that manufacturers will employ these technologies in various combinations, which will likely vary from vehicle to vehicle depending on a vehicle's base emission control package developed for Tier 2 compliance. Moreover, as discussed in section V.D, due to current Tier 2 phase-in schedules, we are not yet in a position to evaluate fully the achievability of standards based on new technologies that may result when Tier 2 is fully phased in in model year 2009. Thus, we are not considering more stringent cold temperature NMHC standards that would require the application of new technology to Tier 2 vehicles.

Chapter 8 of the RIA contains vehicle and nationwide cost estimates, including capital and development costs. We believe the estimated costs are reasonable and the rule is cost-effective, as shown in section XIII, below. Given the emission control strategies currently available, we expect manufacturers to implement these technologies successfully without a significant impact on vehicle noise, energy consumption, or safety factors. Although new emissions control strategies are necessary at cold temperatures, we do not expect fundamental Tier 2 vehicle hardware to change.

Manufacturers commented that the standards will be extremely challenging because the standards are based on full useful life performance and manufacturers must account for fuel quality in the field to ensure adequate performance. Manufacturers also noted that they must account for a host of requirements in addition to the new cold temperature standards, including Tier 2 and SFTP standards. In response, we understand the challenges involved in complying with the new cold temperature standards and we are providing the essential lead time for manufacturers to identify and resolve any related issues as part of overall vehicle development. We are also including several other provisions discussed below, including an averaging

program, phase-in, emissions credits, deficit carry-forward, and in-use standards that provide manufacturers with flexibility in transitioning to the new standards.

a. Currently Available Emission Control Technologies

We believe that the cold temperature NMHC standards for gasoline-fueled vehicles being finalized today are challenging but attainable with Tier 2 (i.e., existing) level emission control technologies. Our determination of feasibility is based on the emission control hardware and calibration strategies used today on Tier 2 vehicles. These emission control technologies are utilized to meet the stringent Tier 2 standards for HC at the FTP temperature range of 68 °F to 86 °F, but are not generally used or activated at colder temperatures. As discussed in section V.D, the standards we are finalizing today will not force changes to Tier 2 compliance strategies. Many current engine families already achieve emissions levels at or below the emission standards being adopted (see RIA Chapter 5) and accomplish this through software and calibration control technologies. However, a significant number of engine families emit more than twice the level of the new standards most likely because they fail to use the Tier 2 control technologies at colder temperatures. We believe the new standards can be met by the application of calibration and software approaches similar to those currently used at 75 °F. Although manufacturers could use additional hardware to facilitate compliance with the new standard, we are not projecting that they would choose to do so because the standards can be achieved through lower-cost calibration and software strategies. As described in section V.B.2.c, our own feasibility testing of a vehicle over 6000 lbs GVWR achieved NMHC reductions consistent with the standard through calibration approaches alone.

In 2002, the European Union (EU) finalized a -7°C (20 °F) cold HC requirement.¹⁴⁵ While the European standard is based on a different drive cycle, manufacturers have developed individual strategies to comply with this standard. When the EU implemented the new cold HC standard in conjunction with a new 75 °F standard (Euro4), many manufacturers responded by employing National Low Emission

Vehicle (NLEV)¹⁴⁶ level hardware and supplementing it with advanced cold start emission control strategies. The EU similarly determined that heavier weight vehicles may have duty-cycle based design limitations and also adopted a separate unique emission standard for these vehicles. Many manufacturers offer common vehicle models in both European and U.S. markets. Such manufacturers can leverage European models to transfer emission control technologies successfully used for 20 °F hydrocarbon control in Europe to their U.S. model counterparts.

There are several strategies used in the vehicles that are achieving proportional improvements in NMHC emissions at 20 °F FTP. Calibration and software strategies that can be used include lean limit fuel strategies, fuel injection timing,¹⁴⁷ elevated idle speeds, retarded spark timing, redundant spark timing, and accelerated closed loop times. These strategies are consistently and successfully used at 75 °F to meet stringent Tier 2 standards. We expect that software and/or calibration changes will perform as well or better than added hardware. This is because some hardware such as the improved catalyst system may not be usable immediately following the cold start because it must warm-up to operate efficiently. Calibration and software strategies that minimize emissions produced by the engine during this period while simultaneously accelerating usage of the catalyst will be more effective than most new hardware options. See RIA Chapter 5 for further discussion.

In addition to calibration strategies, some manufacturers may comply with the new standards by extending the use of existing Tier 2 hardware to 20 °F. An example of this is secondary air systems. Several European models sold in the U.S. market demonstrate excellent cold HC performance and utilize secondary air systems from 75 °F to 20 °F start temperatures. The secondary air systems reduce emissions by injecting ambient air into the exhaust, thus supplying oxygen for more complete combustion. This also supplies supplemental heat to the catalyst. These systems have been used extensively to reduce hydrocarbon emissions at 75 °F starts. Currently, auto

¹⁴⁶ NLEV voluntary program introduced California low emission cars and light-duty trucks (0–6000 lbs. GVW) into other states beginning in 1999.

¹⁴⁷ Meyer, Robert and John B. Heywood, "Liquid Fuel Transport Mechanisms into the Cylinder of a Firing Port-Injected SI Engine During Start-up," SAE 970865, 1997.

¹⁴⁵ European Union (EU) Type VI Test (-7°C) required for new vehicle models certified as of 1/1/2002.

makers are equipping a portion of the Tier 2 fleet with secondary air systems for compliance with Tier 2 standards.

Some manufacturers with vehicles containing secondary air systems claimed that they are not utilizing them at temperatures below freezing simply because of past engineering issues. Those successfully using secondary air at 20 °F (mainly European companies) indicated that these challenges have been addressed through design changes. The robustness of these systems below freezing has also been confirmed with the manufacturers and with the suppliers of the secondary air components.¹⁴⁸ While alternative technologies are available and produce comparable results, vehicles equipped with secondary air technology should meet the new 20 °F standard by utilizing it at colder temperatures.

b. Feasibility Considering Current Certification Levels, Deterioration and Compliance Margin

The standards we are finalizing will have a full useful life of 120,000 miles, consistent with Tier 2 standards. We believe the 0.3 g/mile FEL standard leaves adequate flexibility for compliance margins and any emissions deterioration concerns. Of the vehicles certified to Tier 2 with available cold temperature certification data, approximately 20% of vehicles below 6,000 lbs GVWR had HC levels in the range of 0.18 to 0.27 g/mile, which is two to three times the 75 °F Tier 2 bin 5 full useful life standard. These reported HC levels are from Cold CO test results for certification test vehicles with typically only 4,000 mile aged systems, without full useful life deterioration applied. Rapid advances in emission control hardware technology have lowered deterioration factors used by manufacturers to demonstrate full useful life compliance, usually indicating little or no deterioration over a vehicle's lifetime. These deterioration factors are common across all required test cycles including cold temperature testing. Additionally, manufacturers typically incorporate a 20% to 30% compliance margin to

account for in-use issues that may cause emissions variability. See RIA Chapter 5 for further discussion and details regarding current certification levels.

c. Feasibility and Test Programs

While a few of the heavier vehicles achieved emission levels below the 0.5 g/mile level, there are only limited 20 °F certification results for Tier 2 compliant vehicles over 6000 lbs GVWR because the Tier 2 standards are still phasing in for these vehicles. Prior to proposal, we conducted a feasibility study in 20 °F conditions for Tier 2 vehicles over 6000 lbs GVWR. The test program further investigated the feasibility of compliance for heavier vehicles and assessed their capabilities with typical Tier 2 hardware. For one vehicle with models above and below 6,000 lbs GVWR, we reduced HC emissions by 60–70%, depending on the control strategy. This vehicle had a baseline level of about 1.0 g/mile. The results are well within the 0.5 g/mile standard including compliance margin, and within a 0.3 g/mile level on some tests. We achieved these reductions through recalibration without the use of new hardware.

Comments from the auto industry suggested that the original single vehicle feasibility test program and the approach used to reduce emission levels on the feasibility vehicle were too simplistic and did not fully account for competing requirements. The commenter stated that that Tier 2 FTP and SFTP requirements have affected hardware decisions, such as catalyst location, and make it more difficult to simultaneously obtain optimal performance at colder temperatures. For the final rule, we completed a second feasibility program to help address the comments regarding the first feasibility program. For the second feasibility test program, we tested a vehicle with some of the specific challenges listed by the auto industry which represented a worst case vehicle from the perspective of cold temperature emissions control including catalyst location and a large displacement engine. The second feasibility program utilized emission

control methods already practiced in the production European version of the vehicle tested, helping to demonstrate that significant emission controls through calibration are available to manufacturers today. Simply utilizing the European emission controls resulted in a 32% reduction in NMHC emissions. The findings from both studies are provided in detail in the RIA.

While the auto industry did not question the feasibility of the standards, they expressed concerns that EPA was not conveying the complexity of effort required for full product line manufacturers to meet the new standards. We believe that the feasibility program demonstrated that Tier 2 vehicles, including higher weight vehicles, currently have existing emission control capabilities to achieve the new standards. The extensive emission data from certification tests detailed in RIA Chapter 5 provides substantial support to the assessment that Tier 2 vehicles generally possess the necessary technology to achieve the new standards. In most cases, the technologies need to be activated and optimized at colder temperatures through calibration strategies. However, we recognize that manufacturers, particularly full line manufacturers, will have to do significant development work to bring their expansive Tier 2 product line into compliance with the new standards over the vehicles' full useful life. This is why we have included a phase-in of the standards over 6 model years.

4. Standards Timing and Phase-In

a. Phase-In Schedule

As proposed, we will begin implementing the standard in the 2010 model year (MY) for LDV/LLDTs and 2012 MY for HLDT/MDPVs. The implementation schedule, in Table V.B–2, begins three model years after the Tier 2 phase-in is complete for each vehicle class. Manufacturers will demonstrate compliance with phase-in requirements through sales projections, similar to Tier 2, as discussed below in Section V.B.7.

TABLE V.B–2.—PHASE-IN SCHEDULE FOR 20 °F NMHC STANDARD BY MODEL YEAR

Vehicle GVWR (category)	2010	2011	2012	2013	2014	2015
<6000 lbs (LDV/LLDT)	25%	50%	75%	100%	.....	.....
>6000 lbs HLDT and MDPV .....	.....	.....	25%	50%	75%	100%

¹⁴⁸ Memo to docket "Discussions Regarding Secondary Air System Usage at 20°F with European

Automotive Manufacturers and Suppliers of Secondary Air Systems," December 2005.

We requested comments on the proposed start date and duration of the phase-in schedule. Generally, manufacturers supported the phase-in schedule. Commenters indicated that the stringency of the standards will increase the development workload and facility demands, but that the proposed rule recognized these cost issues and provided sufficient mechanisms for phase-in flexibility to help manufacturers transition to the new program. One manufacturer with only LDV and LLDT vehicles in their product line commented that the required phase-in percentage affects a larger portion of their products compared with other manufacturers with heavier vehicles, and therefore the phase-in should be extended to accommodate construction of new facilities. Conversely, a non-profit organization commented that EPA should begin the program earlier than we proposed. The organization cited our assessment that manufacturers could utilize primarily calibration and software changes, and not hardware changes, to achieve compliance. However, as discussed below, we believe that the finalized start date and phase-in schedule will achieve the greatest amount of emissions reductions in the shortest feasible amount of time.

EPA must consider lead time in determining the greatest degree of emission reduction achievable under section 202(l) of the Clean Air Act. Also, for vehicles above 6,000 GVWR, section 202(a) of the Act requires that four years of lead time be provided to manufacturers. We believe that lead time and phase-in schedule is needed to allow manufacturers to develop compliant vehicles without significant disruptions in their product development cycles. The three-year period between completion of the Tier 2 phase-in and the start of the new cold NMHC standard should provide vehicle manufacturers sufficient lead time to design their compliance strategies and to determine the product development plans necessary to meet the new standards.

We recognize that the new cold temperature standards we are finalizing could represent a significant new challenge for many manufacturers and development time will be needed. The issue of NMHC control at cold temperatures was not anticipated by many entities, and research and development to address the issue is consequently at a rudimentary stage for some manufacturers. Lead time is therefore necessary before compliance can be demonstrated. While certification will only require one vehicle model of a durability group to be tested,

manufacturers must do development on all vehicle combinations to ensure full compliance within the durability test group. A phase-in is needed because manufacturers must develop control strategies for several vehicle lines. Since manufacturers cannot be expected to implement the standard over their entire product line in 2010, we believe a phase-in allows the program to begin sooner than would otherwise be feasible.

As noted at proposal, the lead time and phase-in are also needed to address test facility availability issues (see 71 FR 15849). Prior to proposal, manufacturers raised concerns that a rapid phase-in schedule would lead to a significant increase in the demand for their cold testing facilities, which could necessitate substantial capital investment in new cold test facilities to meet development needs. This is because manufacturers would need to use their cold testing facilities not only for certification but also for vehicle development. Durability test groups may be large and diverse and therefore require significant development effort and cold test facility usage for each model. If vehicle development is compressed into too narrow a time window, significant numbers of new facilities would be needed. Manufacturers were also concerned that investment in new test facilities would be stranded at the completion of the initial development and phase-in period.

We took these concerns into consideration when drafting our proposed rule and are finalizing the start date and phase-in as proposed because we continue to believe they address these issues adequately. Our finalized phase-in period accommodates test facilities and work load concerns by distributing these fleet phase-in percentage requirements over a four-year period for each vehicle weight category (six years total). The staggered start dates for the phase-in schedule between the two weight categories should further alleviate manufacturers' burden regarding construction of new test facilities. We recognize that some manufacturers may still determine that upgrades to their current cold facility are needed to handle increased workload, or that additional shifts must be added to their facility work schedules that are not in place today. The lead time provided and the four-year phase-in period provides needed time for vehicle manufacturers to develop a compliance schedule that does not significantly interfere with their future product plans. Manufacturers commented in support of

the lead time and phase in provided, commenting that these program elements are needed to avoid high test facility costs.

b. Alternative Phase-In Schedules

We are finalizing provisions, as proposed, that allow manufacturers to introduce vehicles earlier than required in exchange for flexibility to make offsetting adjustments, on a one-for-one basis, to the phase-in percentages in later years. Alternative phase-in schedules essentially credit the manufacturer for its early or accelerated efforts and allow the manufacturer greater flexibility in subsequent years during the phase-in. Under these alternative schedules, manufacturers would have to introduce vehicles that meet or surpass the NHMC average standards before they are required to do so, or else introduce vehicles that meet or surpass the standard in greater quantities than required.

As proposed, we are finalizing provisions allowing manufacturers to apply for an alternative phase-in schedule that would still result in 100% phase-in by 2013 and 2015, respectively, for the lighter and heavier weight categories. As with the primary phase-in, manufacturers would base an alternative phase-in on their projected sales estimates. An alternate phase-in schedule submitted by a manufacturer would be subject to EPA approval and would need to provide the same emissions reductions as the primary phase-in schedule. The alternative phase-in cannot be used to delay full implementation past the last year of the primary phase-in schedule (2013 for LDVs/LDTs and 2015 for HLDTs/MDPVs).

As proposed, this alternative phase-in schedule will be acceptable if it passes a specific mathematical test (see 71 FR 15849). We have designed the test to provide manufacturers a benefit from certifying to the standards early, while ensuring that significant numbers of vehicles are introduced during each year of the alternative phase-in schedule. Manufacturers will multiply their percent phase-in by the number of years the vehicles are phased in prior to the second full phase-in year. The sum of the calculation will need to be greater than or equal to 500, which is the sum from the primary phase-in schedule ($4 \times 25 + 3 \times 50 + 2 \times 75 + 1 \times 100 = 500$). For example, the equation for LDVs/LLDTs will be as follows:

$$(6 \times \text{API}_{2008}) + (5 \times \text{API}_{2009}) + (4 \times \text{API}_{2010}) + (3 \times \text{API}_{2011}) + (2 \times \text{API}_{2012}) + (1 \times \text{API}_{2013}) \geq 500\%$$

where "API" is the anticipated

phase-in percentage for the referenced model year

As described above, the final sum of percentages for LDVs/LDTs must equal or exceed 500 – the sum that results from a 25/50/75/100 percent phase-in. For example, a 10/25/50/55/100 percent phase-in for LDVs/LDTs that begins in 2009 will have a sum of 510 percent and is acceptable. A 10/20/40/70/100 percent phase-in that begins the same year has a sum of 490 percent and is not acceptable.

To ensure that significant numbers of compliant LDVs/LDTs are introduced in the 2010 time frame (2012 for HLDT/MDPVs), manufacturers would not be allowed to use alternative phase-in schedules that delay the implementation of the requirements, even if the sum of the phase-in percentages ultimately meets or exceeds 500. Such a situation could occur if a manufacturer delayed implementation of its compliant production until 2011 and began an 80/85/100 percent phase-in that year for LDVs/LDTs. To protect against this possibility, we are finalizing, as proposed, that for any alternative phase-in schedule, the manufacturer's API × year factors for LDV/LLDTs from the 2010 and earlier model years (2012 and earlier for HLDT/MDPVs) sum to at least 100. The early phase-in also encourages the early introduction of vehicles meeting the new standard or the introduction of such vehicles in greater quantity than required, achieving early emissions reductions.

One commenter recommended that EPA carefully consider the added complexity of allowing alternative phase-in schedules before including these provisions in the final rule. In response, we allowed manufacturers the option of using similar alternative phase-ins for Tier 2 and these provisions have not proven to be detrimental in the implementation of the Tier 2 program. We believe the added flexibility provided to manufacturers helps them to meet the new requirements as soon as possible while also helping to minimize disruptions to their product plans. These benefits offset the complexity added by the alternative phase-in option.

Manufacturers commented that EPA should remove the requirement for 2010 to have a sum of 100 because it limits flexibility and could cause manufacturers to run a deficit early in the program. We are retaining this requirement as proposed, except for the option discussed in the next paragraph. In general, this requirement ensures that

manufacturers introduce complying vehicles early in the phase-in. The alternative phase-in is not intended to postpone introduction of compliant vehicles; instead, it is to allow an accelerated introduction of vehicles and to allow manufacturers the flexibility of aligning compliance with production schedules. The commenter's suggestion of removing the sum of 100 provision for MY 2010 and earlier vehicles would essentially amount to delaying the program by one year. Since all manufacturers make LDV/LDTs, the sum of 100 provision ensures that environmental benefits are achieved as soon as possible, while the alternative phase-in provision as a whole provides additional flexibility to manufacturers.

As described above, we proposed an early-year requirement for alternative phase-in schedules for HLDTs/MDPVs (see 71 FR 15850). Similar to the LDV/LDT requirement, we proposed that the API × year factors from the 2012 and earlier model years sum to at least 100. We are finalizing the option of electing an HLDT/MDPV alternative phase-in that meets the 500% criteria, including the 100% criteria for model years 2012 and earlier, as proposed. However, based upon comments received, we are revising this provision to allow additional flexibilities. The comments pointed out that such a requirement would pose significant hardship for limited-line manufacturers who produce only a narrow range of HLDTs/MDPVs. For example, a manufacturer who only sells one configuration in the HLDT/MDPV category would not have the option of certifying only 25% of these vehicles in 2012. To meet our proposed criteria, that manufacturer would have to ensure that the model is fully compliant in 2012 (i.e., 100% of their HLDTs/MDPVs), eliminating any flexibility for these manufacturers. To address this concern, we are allowing HLDT/MDPV manufacturers the additional option of employing a phase-in not meeting the early year requirement (sum of 100 in 2012) as long as their full phase-in is accelerated. Under this option, we are requiring only that the full alternative phase-in equation may meet or exceed 600% for HLDTs/MDPVs. We believe this will still yield environmental benefits as quickly as possible, while not putting an unreasonable burden on limited-line manufacturers of HLDTs/MDPVs. Manufacturers with limited HLDT/MDPV product offerings will still achieve 100 percent phase-in of the HLDTs/MDPVs before the end of the phase-in schedule in 2015. For example, a manufacturer that only has one HLDT/

MDPV family and achieves 100% phase-in in 2013 would have a sum of 600% in the equation:

$$(6 \times 0) + (5 \times 0) + (4 \times 0) + (3 \times 100\%) + (2 \times 100\%) + (1 \times 100\%) = 600\%$$

As noted above, phase-in schedules, in general, add little flexibility for manufacturers with limited product offerings because a manufacturer with only one or two test groups cannot take full advantage of a 25/50/75/100 percent or similar phase-in. Therefore, consistent with our proposal which reflected the recommendations of the Small Advocacy Review Panel (SBAR Panel), which we discuss in more detail later in section V.E, manufacturers meeting EPA's definition of "small volume manufacturer" will be exempt from the phase-in schedules and will be required simply to comply with the final 100% compliance requirement. This provision will only apply to small volume manufacturers and not to small test groups of larger manufacturers.

5. Certification Levels

Manufacturers typically certify groupings of vehicles called durability groups and test groups, and they have some discretion on what vehicle models are placed in each group. A durability group is the basic classification used by manufacturers to group vehicles to demonstrate durability and to predict deterioration. A test group is a basic classification within a durability group used to demonstrate compliance with FTP 75 °F standards.¹⁴⁹ For Cold CO, manufacturers certify on a durability group basis, whereas for 75 °F FTP testing, manufacturers certify on a test group basis. In keeping with the current cold CO standards, we are requiring testing on a durability group basis for the cold temperature NMHC standard, as proposed (see 71 FR 15850). Manufacturers will have the option of certifying on the smaller test group basis, as is allowed under current cold CO standards. Testing on a test group basis will require more tests to be run by manufacturers but may provide them with more flexibility within the averaging program. In either case, the worst-case vehicle within the group from an NMHC emissions standpoint must be tested for certification.

For the new standard (and consistent with certification for most section 202 standards), manufacturers will declare a family emission limit (FEL) for each group either at, above, or below the fleet averaging standard. The FEL must be based on the certification NMHC level, including deterioration factor, plus the

¹⁴⁹ 40 CFR 86.1803-01.

compliance margin manufacturers feel is needed to ensure in-use compliance. The FEL becomes the standard for each group, and each group could have a different FEL so long as the projected sales-weighted average level met the fleet average standard at time of certification. Like the standard, the FEL will be set at one significant digit to the right of the decimal point.

Manufacturers will compute a sales-weighted average for the NMHC emissions at the end of the model year and then determine credits generated or needed based on how much the average is above or below the standard.

One commenter questioned if the FEL approach would interfere with the Tier 2 program, which uses bins rather than FELs. We do not believe that the two approaches create a conflict because compliance with Tier 2 and the cold temperature standards operate independent of one another. Tier 2 standards and bins are not a factor when manufacturers demonstrate compliance with the cold temperature standards.

6. Credit Program

As described above, we are finalizing proposed provisions allowing manufacturers to average the FELs for NMHC emissions by sales of their vehicles and comply with a corporate average NMHC standard (see 71 FR 15850). In addition, we are finalizing, as proposed, banking and trading provisions: when a manufacturer's average NMHC emissions from vehicles certified and sold falls below the corporate average standard, the manufacturer may generate credits that it could save for later use (banking) or transfer to another manufacturer (trading). Manufacturers must consume any credits if their corporate average NMHC emissions were above the applicable standard for the weight class.

As proposed, credits may be generated prior to, during, and after the phase-in period. Manufacturers could certify LDVs/LLDTs to standards as early as the 2008 model year (2010 for HLDTs/MDPVs) and receive early NMHC credits for their efforts. They could use credits generated under these "early banking" provisions after the phase-in begins in 2010 (2012 for HLDTs/MDPVs).

One organization opposed the use of credits from one weight class to offset debits in another weight class. However, EPA views the averaging, banking, and trading (ABT) provisions as an important element in setting emission standards reflecting the greatest degree of emission reduction achievable, considering factors including cost and lead time. If there are vehicles that will

be particularly costly or have a particularly hard time coming into compliance with the standard, the ABT program allows a manufacturer to adjust the compliance schedule accordingly, without special delays or exceptions having to be written into the rule. This is an important flexibility especially given the current uncertainty regarding optimal technology strategies for any given vehicle line. In these circumstances, ABT allows us to consider a more stringent emission standard than might otherwise be achievable under the Clean Air Act, since ABT reduces the cost and improves the technological feasibility of achieving the standard. By enhancing the technological feasibility and cost-effectiveness of the new standard, ABT allows the standard to be attainable earlier than might otherwise be possible. Also see, e.g., 69 FR 38996–97, (June 19, 2004), which discusses an ABT program for nonroad diesel engines, which allows for use of credits across engine families. This type of credit use can be important in enhancing standards' overall technical feasibility, cost-effectiveness, and pace of implementation.

a. How Credits Are Calculated

As proposed, the corporate average for each weight class will be calculated by computing a sales-weighted average of the FEL NMHC levels to which each group was certified. As discussed above, manufacturers will group vehicles into durability groups or test groups and establish an FEL for each group. This FEL becomes the standard for that group. Consistent with FEL practices in other vehicle standards, manufacturers may opt to select an FEL above the test level. The FEL will be used in calculating credits. The number of credits or debits will then be determined using the following equation:

$$\text{Credits or Debits} = (\text{Standard} - \text{Sales-weighted average of FELs to nearest tenth}) \times \text{Actual Sales}$$

If a manufacturer's average was below the 0.3 g/mi corporate average standard for LDVs/LDTs (below 0.5 g/mi for HLDTs/MDPVs), credits would be generated. These credits could then be used in a future model year when its average NMHC might exceed the 0.3 or the 0.5 standard. Conversely, if the manufacturer's fleet average was above the corporate average standard, banked credits could offset the difference, or credits could be purchased from another manufacturer.

b. Credits Earned Prior to Primary Phase-In Schedule

As proposed, we are finalizing provisions allowing manufacturers to earn early emissions credits if they introduce vehicles that comply with the new standards early and the corporate average of those vehicles is below the applicable standard. Early credits could be earned starting in model year 2008 for vehicles meeting the 0.3 g/mile standard and in 2010 for vehicles meeting the 0.5 g/mile standard. These emissions credits generated before the start of the phase-in could be used both during and after the phase-in period and have all the same properties as credits generated by vehicles subject to the primary phase-in schedule. As mentioned in section V.B.4.b above, we are also finalizing a provision that allows manufacturers to apply for an alternative phase-in schedule for vehicles that are introduced early. The alternative phase-in and early credits provisions would operate independent of one another.

c. How Credits Can Be Used

A manufacturer can use credits in any future year when its corporate average is above the standard, or it can trade (transfer) the credits to other manufacturers. Because of separate sets of standards for the different weight categories, we are finalizing as proposed that manufacturers compute their corporate NMHC averages separately for LDV/LLDTs and HLDTs/MDPVs. Credit exchanges between LDVs/LLDTs and HLDTs/MDPVs will be allowed. This will provide added flexibility for full-line manufacturers who may have the greatest challenge in meeting the new standards due to their wide disparity of vehicle types/weights and emissions levels.

d. Discounting and Unlimited Life

Credits will allow manufacturers a way to address unexpected shifts in their sales mix. The NMHC emission standards in this program are quite stringent and do not present easy opportunities to generate credits. Therefore, we will not discount unused credits. Further, the degree to which manufacturers invest the resources to achieve extra NMHC reductions provides true value to the manufacturer and to the environment. We do not want to take measures to reduce the incentive for manufacturers to bank credits, nor do we want to take measures to encourage unnecessary credit use. Consequently, NMHC credits will not have a credit life limit. However, credits may only be used to offset deficits

accrued with respect to the new 0.3/0.5 g/mile cold temperature standards, and cannot be used in Tier 2 or other programs.

e. Deficits Can Be Carried Forward

When a manufacturer has an NMHC deficit at the end of a model year—that is, its corporate average NMHC level is above the required corporate average NMHC standard—the manufacturer will be allowed to carry that deficit forward into the next model year. To prevent deficits from being carried forward indefinitely, we are finalizing, as proposed, that manufacturers will not be permitted to run a deficit for two years in a row. A deficit carry-forward may only occur after the manufacturer used any banked credits. If the deficit still exists and the manufacturer chooses not to, or is unable to, purchase credits, the deficit will be carried over. At the end of that next model year, the deficit must be covered with an appropriate number of credits that the manufacturer generated or purchased. Any remaining deficit means that the manufacturer is not in compliance and can be subject to an enforcement action.

We believe that it is reasonable to provide this flexibility to carry a deficit for one year given the uncertainties that manufacturers face with changing market forces and consumer preferences, especially during the introduction of new technologies. These uncertainties can make it hard for manufacturers to accurately predict sales trends of different vehicle models.

f. Voluntary Heavy-Duty Vehicle Credit Program

In addition to MDPV requirements in Tier 2, we also currently have chassis-based emissions standards for other complete heavy-duty vehicles (e.g., large pick-ups and cargo vans) above 8,500 pound GVWR. However, these standards do not include cold temperature CO standards. As noted below in section V.B.6.a, we did not propose to apply cold temperature NMHC standards to heavy-duty gasoline vehicles due to a current lack of emissions data on which to base such standards. Accordingly, the final rule does not contain any provisions for heavy-duty vehicle standards or credit program.

Our proposal discussed a few ideas for voluntary approaches where manufacturers could earn credits by including heavy-duty gasoline vehicles in the program. We only received one comment regarding a voluntary credit program for heavy-duty gasoline vehicles. The organization that submitted the comment opposed the

creation of NMHC credits applicable to other vehicle categories generated by reductions from heavy-duty vehicles. In light of this lack of support, as well as insufficient data, we are not including a heavy-duty standard or credit program at this time. We plan to revisit the need for and feasibility of standards as data become available.

7. Additional Vehicle Cold Temperature Standard Provisions

a. Applicability

As proposed, the new cold temperature NMHC standards apply to all gasoline-fueled light-duty vehicles and MDPVs sold nationwide. The cold NMHC standards do not apply to diesel vehicles, alternative-fueled vehicles, or to the non-gasoline portion of flex fuel vehicles (FFVs).¹⁵⁰ We are finalizing as proposed that FFVs will still require certification to the applicable cold NMHC standard, though only when operated on gasoline. FFVs operating on ethanol are not subject to the cold standard. When manufacturers submit their application for certification for FFVs (such as FFVs that can run on gasoline or E85¹⁵¹), the FFVs must have been tested using gasoline. The application must also include a statement that either confirms the same control strategies used with gasoline will be used when operating on ethanol, or that identifies any differences as an Auxiliary Emission Control Device (AECD). Again, dedicated alternative-fueled vehicles are not covered.

We requested comment on standards for vehicles operating on fuels other than gasoline. Vehicle manufacturers agreed that the cold NMHC standards should not apply to diesels and alternative fuel vehicles, stating that the standard would capture all but a very small percentage of air toxics emissions from the light-duty onroad fleet. We also received comments in support of a standard for diesel vehicles. One organization argued that the EPA must exercise its authority to gather the necessary data and establish a cold temperature NMHC standard for diesel, alternative fuel, and FFVs, or explain why such standards are not needed.

A comprehensive assessment of appropriate standards for diesel vehicles will require a significant amount of investigation and analysis of issues such

¹⁵⁰ In this preamble, we use the term flex fuel vehicle (FFV) to mean a vehicle capable of operating on two or more different fuel types, either separately or simultaneously. Most FFVs available today run on gasoline and ethanol mixtures. EPA regulations use the term "multi-fuel vehicle" when referring to these vehicles.

¹⁵¹ E85 is a fuel mixture consisting of 85% ethanol and 15% gasoline.

as feasibility and costs. While we have significant amounts of data on which to base our final standards for light-duty gasoline vehicles, we have very little data for light-duty diesels. Currently, diesel vehicles are not subject to the cold CO standard, so, unlike the situation for gasoline motor vehicles where some certification data under cold temperature conditions are available, there is very limited data available on diesel cold temperature emissions. Also, many manufacturers are currently in the process of developing their diesel product offerings and the cold temperature performance of these vehicles cannot yet be evaluated.

Therefore, at this time, the cold NMHC standards will not apply to light-duty diesel vehicles. We will continue to evaluate data for these vehicles as they enter the fleet and will reconsider the need for standards. We have adopted cold temperature FTP testing for diesels as part of the Fuel Economy Labeling rulemaking, including NMHC measurement.¹⁵² These testing data would allow us to assess diesel NMHC certification levels over time. There are sound engineering reasons, however, to expect cold NMHC emissions for diesel vehicles to be as low as or even lower than those required for gasoline vehicles in the finalized standards. This is because diesel engines operate with leaner air-fuel mixtures compared to gasoline engines. Therefore diesels have fewer engine-out NMHC emissions due to the abundance of oxygen and more complete combustion. A very limited amount of confidential manufacturer-furnished information is consistent with this engineering hypothesis.

With respect to FFVs, although FFVs are currently required to certify to the cold CO standards at 20 °F while operating on gasoline, there is no cold testing requirement for these vehicles while operating on the alternative fuel at 20 °F. There are little data upon which to evaluate NMHC emissions when operating on alternative fuels at cold temperatures. For FFVs operating on E85,¹⁵³ it is difficult to develop a reasonable standard due to a lack of fuel specifications, testing protocols, and test data for the 20 °F cold CO cycle. Standards reflecting use of other fuels such as methanol and natural gas pose similar uncertainty. As in the case of diesels, it will take time to gain an

¹⁵² "Fuel Economy Labeling of Motor Vehicles; Revisions to Improve Calculations of Fuel Economy Estimates," Final Rule, 71 FR 77872, December 27, 2006.

¹⁵³ E85 is a fuel mixture consisting of 85% ethanol and 15% gasoline typical of a summer blend of an ethanol based alternative fuel.

understanding of these other technologies in sufficient detail to support a rulemaking. Therefore, as proposed, we are not adopting a cold NMHC testing requirement for FFVs while operating on the non-gasoline fuel or for alternative fuel vehicles under this final rulemaking. However, for FFVs, we are requiring confirmation that emission controls used when operating on gasoline are also used when operating on the non-gasoline fuel unless a reasonable exception why they cannot be used is declared. We will continue to investigate these other technologies.

Between the proposed rule and today's final rule, we conducted an initial emissions testing program on a limited number of FFVs operated on several blends of gasoline and ethanol at normal test temperatures and 20 °F.¹⁵⁴ These vehicles were tested on summer gasoline and E85 under normal test temperatures and on winter gasoline and E70¹⁵⁵ at 20 °F. HC emissions were significantly higher with E70 fuel than with gasoline, with the HC emissions largely consisting of unburned ethanol generated during the cold start. The reason for the elevated HC emission levels is that during cold starts, ethanol, which is an MSAT, does not readily burn in the combustion chamber due to its higher boiling point (approximately 180 °F). FFVs must start on the gasoline portion of the alternative fuel, which can compose as little as 15% of the alternative fuel. Ethanol emissions are further increased at colder temperatures because the lower engine start temperature will require an increasing amount of the fuel mixture to start the vehicle and subsequently more unburned ethanol can escape the combustion process. However, the testing also indicates significantly lower benzene emission levels for FFVs when operating on the high ethanol blends. Benzene was 30% to 90% lower on E85 and approximately 30% lower on E70 compared to the levels when run on gasoline. Acetaldehyde emissions are significantly higher with E85 relative to

emissions from gasoline-fueled vehicles, since it is a byproduct of partial (i.e., incomplete) ethanol combustion. In addition, some other VOC-based toxics emissions were generally lower with the vehicles running on E85 and E70 compared with gasoline.

There are many issues that must be resolved before we are able to establish a cold temperature standard for FFVs when run on E85 (and E70 at cold temperatures). These include feasibility (i.e., levels that are technically achievable), cost, test procedures, test fuel specifications and the appropriate form of the standard. For example, because much of the VOC emissions from FFVs operating on the high ethanol blends at cold temperatures is unburned ethanol, we may need to consider whether higher NMHC level would be justified or whether an NMHC minus ethanol standard would have merit. We plan to address these issues as part of a broader assessment of E85 emissions regulatory issues in the future.

One organization commented that EPA must establish cold temperature standards for heavy-duty vehicles. Since there is no 20 °F cold standard for heavy-duty vehicles, we have no data for heavy-duty gasoline-fueled vehicles, but we would expect a range of emissions performance similar to that of lighter gasoline-fueled trucks. Due to the lack of test data on which to base feasibility and cost analyses, we did not propose cold temperature NMHC standards for these vehicles. As mentioned previously, we plan to revisit this issue when sufficient data become available.

b. Useful Life

We are adopting the proposed requirement that the new cold temperature standards must be met over the full useful life of the vehicle, consistent with other emissions standards for Tier 2 vehicles. The "useful life" of a vehicle means the period of use or time during which an emission standard applies to light-duty vehicles and light-duty trucks.¹⁵⁶ Given that we expect that manufacturers will make calibration or software changes to existing Tier 2 technologies, it is reasonable for the new cold temperature

standards to have the same useful life as the Tier 2 standards. For LDV/LLDT, the full useful life values will be 120,000 miles or 10 years, whichever comes first, and for HLDV/MDPV, full useful life is 120,000 miles or 11 years, whichever comes first.¹⁵⁷ We did not receive any comments regarding these useful life provisions.

c. High Altitude

We do not expect emissions to be significantly different at high altitude due to the use of common emissions control calibrations. Limited data submitted by a manufacturer suggest that FTP emissions performance at high altitude generally follows sea level performance. Furthermore, there are very limited cold temperature testing facilities at high altitudes. Therefore, under normal circumstances, manufacturers will not be required to submit vehicle test data for high altitude. Instead, manufacturers will be required to submit an engineering evaluation indicating that common calibration approaches will be utilized at high altitude. Any deviation from sea level in emissions control practices must be included in the auxiliary emission control device (AECDD) descriptions submitted by manufacturers at certification. In addition, any AECDD specific to high altitude must include engineering emission data for EPA evaluation to quantify any emission impact and validity of the AECDD. We did not receive any comments regarding these provisions relating to altitude.

d. In-Use Standards for Vehicles Produced During Phase-In

As proposed, we are finalizing provisions for an in-use standard that is 0.1 g/mile higher than the certification FEL for any given test group for a limited number of model years. For example, a test group with a 0.2 g/mile FEL would have an in-use standard of 0.3 g/mile. This would not change the FEL or averaging approaches and would only apply in cases where EPA tests vehicles in-use to ensure emissions compliance. Tables V.B-3 and V.B-4 provide the finalized schedule for the availability of the in-use standards.

¹⁵⁴ "Flex Fuel Vehicles (FFVs) VOC/PM Cold Temperature Characterization When Operating on Ethanol (E10, E70, E85)" February, 2007.

¹⁵⁵ E70 is a fuel mixture consisting of 70% ethanol and 30% gasoline typical of a winter blend of an ethanol based alternative fuel.

¹⁵⁶ 40 CFR 86.1803-01.

¹⁵⁷ 40 CFR 86.1805-04.

TABLE V.B-3.—SCHEDULE FOR IN-USE STANDARDS FOR LDVs/LLDTs

Model year of introduction	2008	2009	2010	2011	2012	2013
Models years that the in-use standard is available for carry-over test groups	2008 2009 2010 2011	2009 2010 2011 2012	2010 2011 2012 2013	2011 2012 2013	2012 2013 2014	2013 2014

TABLE V.B-4.—SCHEDULE FOR IN-USE STANDARDS FOR HLDVs/MDPVs

Model year of introduction	2010	2011	2012	2013	2014	2015
Models years that the in-use standard is available for carry-over test groups	2010 2011 2012 2013	2011 2012 2013 2014	2012 2013 2014 2015	2013 2014 2015	2014 2015 2016	2015 2016

This approach is similar to the one adopted in the Tier 2 rulemaking.¹⁵⁸ As we have indicated, the standards we are finalizing will be more challenging for some vehicles than for others. With any new technology, or even with new calibrations of existing technology, there are risks of in-use compliance problems that may not appear in the certification process. In-use compliance concerns may discourage manufacturers from applying new calibrations or technologies. Thus, we believe it is appropriate, for the first few years, for those vehicles most likely to require the greatest applications of effort to provide assurance to the manufacturers that they will not face recall if they exceed standards in use by a specified amount.

The in-use standards will be available for the first few model years of sales after a test group meeting the new standards is introduced, according to a schedule that provides more years for test groups introduced earlier in the phase-in. This schedule provides manufacturers with time to determine the in-use performance of vehicles and learn from the earliest years of the program to help ensure that vehicles introduced after the phase-in period meet the final standards in-use. The in-use compliance margin only applies to carry-over models. That is, once a test group is certified to the new standards, it will be carried over to future model years.

We received one comment on the provisions for an interim in-use standard. A manufacturer commented that the EPA should consider allowing an interim in-use increment greater than 0.1 g/mi to account for known variability in in-use conditions and vehicle technologies. However, we did

not receive any data that supported the manufacturer's assertion, nor any indication of an acceptable increase beyond the 0.1 g/mi increment. Furthermore, no other manufacturers commented on this provision. We believe the 0.1 g/mi increment is sufficient and that anything greater may result in a reduction of emission control. Therefore, the interim in-use standard is finalized as proposed.

8. Monitoring and Enforcement

As proposed, manufacturers must either report that they met the relevant corporate average standard in their annual reports to the Agency, or show via the use of credits that they have offset any exceedance of the corporate average standard. Manufacturers must also report their credit balances or deficits. EPA will monitor the program.

As in Tier 2, the averaging, banking and trading program will be enforced through the certificate of conformity that manufacturers must obtain in order to introduce any regulated vehicles into commerce.¹⁵⁹ The certificate for each test group will require all vehicles to meet the emissions level to which the vehicles were certified, and will be conditioned upon the manufacturer meeting the corporate average standard within the required time frame. If a manufacturer fails to meet this condition, the vehicles causing the corporate average exceedance will be considered to be not covered by the certificate of conformity for that engine family. A manufacturer will be subject to penalties on an individual vehicle basis for sale of vehicles not covered by a certificate.

EPA will review the manufacturer's sales to designate the vehicles that caused the exceedance of the corporate

average standard. We will designate as nonconforming those vehicles in those test groups with the highest certification emission values first, continuing until we reach a number of vehicles equal to the calculated number of noncomplying vehicles, as determined above. In a test group where only a portion of vehicles are deemed nonconforming, we will determine the actual nonconforming vehicles by counting backwards from the last vehicle produced in that test group number. Manufacturers will be liable for penalties for each vehicle sold that is not covered by a certificate.

As proposed, we will condition certificates to enforce the requirements that manufacturers not sell credits that they have not generated. A manufacturer that transfers credits it does not have will create an equivalent negative credit balance or deficit that the manufacturer must make up by the reporting deadline for the same model year. A credit deficit in such cases at the reporting deadline will be a violation of the conditions under which EPA issued the certificate of conformity. EPA will identify the nonconforming vehicles in the same manner described above and nonconforming vehicles will not be covered by the certificate.

In the case of a trade that resulted in a negative credit balance that a manufacturer could not cover by the reporting deadline for the model year in which the trade occurred, both the buyer and the seller will be liable, except in cases involving fraud. We believe that holding both parties liable will induce the buyer to exercise diligence in assuring that the seller has or will be able to generate appropriate credits and will help to ensure that inappropriate trades do not occur.

We did not propose any new compliance monitoring activities or programs for vehicles. These vehicles will be subject to the certification testing provisions of the CAP2000

¹⁵⁸ "Control of Air Pollution from New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements," Final Rule, 65 FR 6796, February 10, 2000.

¹⁵⁹ "Control of Air Pollution from New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements," Final Rule, 65 FR 6797, February 10, 2000.

rule.¹⁶⁰ We are not requiring manufacturer in-use testing to verify compliance. There is no cold CO manufacturer in-use testing requirement today (similarly, we do not require manufacturer in-use testing for SCO3 standards under the Supplemental Federal Test Procedures (SFTP) program largely due to the limited availability of the test facilities). As noted earlier, manufacturers have limited cold temperature testing capabilities and we believe these facilities will be needed for product development and certification testing. However, we have the authority to conduct our own in-use testing program for exhaust emissions to ensure that vehicles meet standards over their full useful life. We will pursue remedial actions when substantial numbers of properly maintained and used vehicles fail any standard in-use. We also retain the right to conduct Selective Enforcement Auditing of new vehicles at manufacturers' facilities.

The use of credits will not be permitted to address Selective Enforcement Auditing or in-use testing failures. The enforcement of the averaging standard will occur through the vehicle's certificate of conformity. A manufacturer's certificate of conformity will be conditioned upon compliance with the averaging provisions. If a manufacturer failed to meet the corporate average standard and did not obtain appropriate credits to cover its shortfalls in that model year or in the subsequent model year (see deficit carry forward provision in section V.B.5.e.), then the certificate for the affected test groups will be void for all past, present, and future sales related to that certificate. Manufacturers will need to track their certification levels and sales unless they produced only vehicles certified to NMHC levels below the standard and did not plan to bank credits. We did not receive any comments on the provisions regarding

Selective Enforcement Auditing or conditions of certification.

C. What Evaporative Emissions Standards Are We Finalizing?

We are finalizing as proposed a set of numerically more stringent evaporative emission standards for all light-duty vehicles, light-duty trucks, and medium-duty passenger vehicles. The standards we are finalizing are equivalent to California's LEV II standards, and these standards are shown in Table V.C-1. The new standards represent about a 20 to 50 percent reduction (depending on vehicle weight class and type of test) in the diurnal plus hot soak standards currently in place for Tier 2 vehicles.¹⁶¹ As with the current Tier 2 evaporative emission standards, the standards we are finalizing vary by vehicle weight class. The increasingly higher standards for heavier weight class vehicles account for larger vehicle sizes and fuel tanks (non-fuel and fuel emissions).¹⁶²

TABLE V.C-1.—FINAL EVAPORATIVE EMISSION STANDARDS
[Grams of hydrocarbons per test]

Vehicle class	3-Day diurnal plus hot soak	Supplemental 2-day diurnal plus hot soak
LDVs	0.50	0.65
LLDTs	0.65	0.85
HLDTs	0.90	1.15
MDPVs	1.00	1.25

1. Current Controls and Feasibility of the New Standards

As described earlier, we are reducing the numerical level of the evaporative emission standards applicable to diurnal and hot soak emissions from light-duty vehicles and trucks by about 20 to 50 percent. These new standards are meant to be effectively the same as the evaporative emission standards in the California LEV II program. Although the new standards are numerically more stringent, as we explained at proposal, we believe they are essentially equivalent to the current Tier 2 standards because of differences in testing requirements (see 71 FR 15854; also see section V.C.5 below for further discussion of such test differences, e.g., test temperatures and fuel volatilities). As discussed in the proposal, this view is supported by manufacturers and by

current industry practices. Based on this understanding, we do not project additional VOC or air toxics reductions from the evaporative standards we are finalizing today.¹⁶³ Also, we do not expect additional costs since we expect that manufacturers will continue to produce 50-state evaporative systems. Therefore, harmonizing the federal and California LEV-II evaporative emission standards will codify (i.e., lock in) the approach manufacturers have already indicated they are taking for 50-state evaporative systems.

We believe this action is an important step to ensure that the federal standards reflect the lowest possible evaporative emissions, and it also will provide states with certainty that the emissions reductions we project to occur due to 50-state compliance strategies will in fact occur. In addition, the new

standards will assure that manufacturers continue to use available fuel system materials to minimize evaporative emissions.

In the proposal, we considered but did not propose more stringent evaporative requirements contained in the partial zero-emission vehicle (PZEV) portion of California's LEV II program. The LEV II program includes PZEV credits for vehicles that achieve near zero emissions (e.g., LDV evaporative emission standards for both the 2-day and 3-day diurnal plus hot soak tests are 0.35 grams/test, which are more stringent than the standards finalized today). State and local air quality organizations commented that EPA should adopt the PZEV evaporative standards. In addition, they indicated that California Air Resources Board estimates the additional per vehicle cost

¹⁶⁰ 71 FR 2810, January 17, 2006.

¹⁶¹ Diurnal emissions (or diurnal breathing losses) means evaporative emissions as a result of daily temperature cycles or fluctuations for successive days of parking in hot weather. Hot soak emissions (or hot soak losses) are the evaporative emissions from a parked vehicle immediately after turning off

the hot engine. For the evaporative emissions test procedure, diurnal and hot soak emissions are measured in an enclosure commonly called the SHED (Sealed Housing for Evaporative Determination).

¹⁶² Larger vehicles may have greater non-fuel evaporative emissions, probably due to an increased

amount of interior trim, vehicle body surface area, and larger tires.

¹⁶³ U.S. EPA, Office of Air and Radiation, Update to the Accounting for the Tier 2 and Heavy-Duty 2005/2007 Requirements in MOBILE6, EPA420-R-03-012, September 2003.

for a PZEV evaporative emission system to be about \$10.20. They commented that EPA should consider the introduction of a similar standard for some vehicles. Moreover, they urged us to commit in the final rule to pursue actions to achieve further evaporative emission reductions in the future.

However, auto manufacturers supported the proposed evaporative emission standards. They indicated that, as EPA tentatively concluded in the proposed rule, it would be inappropriate for EPA to propose more stringent standards. Manufacturers noted that PZEVs have been limited to a small fraction of the light-duty fleet, mainly small 4-cylinder passenger cars, and that the PZEV standard has not proven feasible across the light-duty fleet. Furthermore, it is significantly more costly to comply with the PZEV evaporative emission standard because of significant modifications needed to the evaporative emission control system and fuel system. Also, the auto manufacturers suggested that emission benefits, if any, of the PZEV standard would be minimal.

We have decided not to set more stringent PZEV-equivalent evaporative standards at this time. The limited PZEV vehicles available today require additional evaporative emissions technology or hardware (e.g., modifications to fuel tank and secondary canister) beyond what will be needed for vehicles meeting the new standards that we are adopting today. As we described in the proposed rule, at this time, we need to better understand the evaporative system modifications (i.e., technology, costs, lead time, etc.) potentially needed across the vehicle fleet to meet PZEV-level standards before we can fully evaluate whether it is feasible to consider more stringent standards. For example, at this point we cannot determine whether the PZEV technologies could be used fleetwide or on only a limited set of vehicles. Thus, in the near term, we lack any of the information necessary to determine if further reductions are feasible, and if they could be achievable considering cost, energy and safety issues. Moreover, sufficient new information or data was not provided from commenters on the proposed rule to close these gaps in our understanding. However, we intend to consider more stringent evaporative emission standards in the future.

2. Evaporative Standards Timing

As proposed, we will implement today's evaporative emission standards in model year 2009 for LDVs/LLDTs and model year 2010 for HLDTs/MDPVs.

Many manufacturers already have begun or completed model year 2008 certification. Thus, model year 2009 is the earliest practical start date of new standards for LDVs/LLDTs. For HLDTs/MDPVs, the phase-in of the existing Tier 2 evaporative emission standards ends in model year 2009. Thus, the model year 2010 is the earliest start date possible for HLDTs/MDPVs. As discussed earlier, since we believe that manufacturers already meet these standards, there is no need for additional lead time beyond the implementation dates we are finalizing.

3. Timing for Flex Fuel Vehicles

For FFVs, the phase-in schedule we are finalizing for the new evaporative standards is somewhat different than the phase-in schedule we proposed for these vehicles. In the proposal, we recognized that manufacturers will need a few additional years of lead time to adjust their evaporative systems to comply with the new evaporative emission standards for FFVs operating on the non-gasoline fuel, typically E85 (see 71 FR 15855). The existing regulations require that FFVs or E85 vehicles (vehicles designed to operate on fuel that is 85 percent ethanol and 15 percent gasoline) certify on both gasoline and E10 (E10 is a fuel containing 10 percent ethanol and 90 percent gasoline) for the evaporative emissions test procedure. E10 is considered the "worst case" test fuel for evaporative emissions, because it is the ethanol blend that results in greater evaporative emissions. Thus, E10 is the evaporative certification test fuel for E85 vehicles. Thus far, only a few FFV systems have been certified to California LEV-II standards on E10 fuel. Vehicles not certified with E10 in California are sold as gasoline-fueled only vehicles rather than FFVs. Some manufacturers are still developing FFVs for future introduction and the evaporative control systems in some cases have not been fully field tested and certified on the E10 fuel. Therefore, certifying FFVs to the new standards on the E10 fuel (which is required by Tier 2) represents a new requirement for manufacturers.

We proposed that FFVs would need to meet the new evaporative emission certification standards on the non-gasoline fuel beginning in the fourth year of the program—2012 for LDVs/LLDTs and 2013 for HLDTs/MDPVs. We proposed that the evaporative emission standards would be implemented in 2009 for LDVs/LLDTs and 2010 for HLDTs/MDPVs for the FFVs when run on gasoline (along with gasoline vehicles that are not flex fuel). At the time of proposal, we believed this

additional three years of lead time would provide sufficient time for manufacturers to make adjustments to their new evaporative systems for FFVs, which are limited product lines.

Auto manufacturers commented that additional lead time and flexibility beyond that proposed is needed for the non-gasoline portion of FFVs. Manufacturers requested the following revisions to the proposed timing of the new evaporative emission standards for the non-gasoline portion of FFVs:

- combine the LDV/LLDT and HLDT/MDPV fleets,
- implement the phase-in of this combined fleet starting in 2013, and
- permit a three-year phase-in of 30 percent/60 percent/100 percent for this combined fleet.

The auto industry indicated that for many manufacturers of FFVs, the new standards are considered new emission requirements for their FFVs. This is unlike the situation for gasoline vehicles, where EPA intends to codify what is already being done in practice rather than imposing any new requirements on gasoline vehicles. For most manufacturers of FFVs, there is no demonstrated capability at this time to meet the new evaporative emission standards from which to begin planning compliance to the new standards. Also, manufacturers expressed that there are important enough differences between fuels in the gasoline and FFVs (or the non-gasoline portion of FFVs) that independent evaluations of FFVs on gasoline and the non-gasoline fuel are warranted.

In addition, auto manufacturers stated that as interest in alternative fuels has increased due to energy supply concerns, they are suddenly considering widespread introduction of FFV models, across entire product lines. What was at first a limited offering of a few models may become more offerings across a manufacturer's full line of products in the timeframe of this rulemaking. The auto industry argues that these new developments justify lead time provisions commensurate with those when a new emission requirement applies across a manufacturer's light-duty product line.

They also indicated that model renewals provide the most cost-effective timing for the introduction of new emissions capability to meet the new standards. At this time, some manufacturers plan model renewals for multiple vehicle lines from model years 2013 to 2015. Allowing a three-year phase-in for the non-gasoline portion of FFVs provides more opportunities for scheduled model renewals to coincide

with implementation dates for the new standards. Planning, engineering, and development activities needed to meet these new standards can be incorporated into the model redesign activities.

We believe that many of the concerns presented by manufacturers supporting additional lead time are valid. Most manufacturers have less experience meeting the new standards on the non-gasoline portion of FFVs compared to

gasoline vehicles. The new standards will apply beginning in model year 2012 with a three-year phase-in, 30/60/100 percent, for LDVs/LLDTs and HLDTs/MDPVs grouped together (see Table V.C-2). Although auto manufacturers requested a start date of 2013 for a combined fleet, we believe the additional flexibilities we are providing (three-year phase-in and grouping LDVs/LLDTs and HLDTs/MDPVs together) is sufficient flexibility for the

production of FFVs. There is enough time between now and the implementation dates or phase-in schedule (2012 through 2014) for manufacturers to coordinate model renewals with the introduction of broader product offerings of FFVs. See the Summary and Analysis of Comments of this rulemaking for further discussion of comments and our responses to comments.

TABLE V.C-2.—PHASE-IN SCHEDULE FOR NON-GASOLINE PORTION OF FFVS: EVAPORATIVE EMISSION STANDARDS*

Vehicle GVWR (Category)	2012	2013	2014
≤6000 lbs (LDVs/LLDTs) and > 6000 lbs (HLDTs and MDPVs)	30%	60%	100%

*Phase-in schedules are grouped together for LDVs/LLDTs and HLDTs/MDPVs.

Provisions for in-use evaporative emission standards similar to those described below in section V.C.4 do not apply to the non-gasoline portion of FFVs. We believe that three to five additional years to prepare vehicles (or evaporative families) to meet the certification standards, and to simultaneously make vehicle adjustments from the federal in-use experience of other vehicles (including those that are not FFVs) is sufficient to resolve any issues for FFVs. Also, we did not receive comments requesting additional flexibility beyond the phase-in schedule for certification vehicles discussed earlier. Therefore, we are finalizing our proposal not to provide additional in-use compliance margin to FFVs. According to the phase-in schedule for a combined fleet in Table V.C-2, the evaporative emission standards will apply both for certification and in-use beginning in 2012 for LDVs/LLDTs and HLDTs/MDPVs.

4. In-Use Evaporative Emission Standards

As described earlier in this section, we are adopting evaporative emission standards that are equivalent to California's LEV II standards. Currently, the Tier 2 evaporative emission

standards are the same for certification and in-use vehicles. However, the California LEV II program permits manufacturers to meet less stringent standards in-use for a short time in order to account for potential variability in-use during the initial years of the program when technical issues are most likely to arise.¹⁶⁴ The LEV II program specifies that in-use evaporative emission standards of 1.75 times the certification standards will apply for the first three model years after an evaporative family is first certified to the LEV II standards (only for vehicles introduced prior to model year 2007, the year after 100 percent phase-in).^{165 166} An interim three-year period was considered sufficient to accommodate any technical issues that may arise.

Federal in-use conditions may raise unique issues (e.g., salt/ice exposure) for evaporative systems certified to the new standards (which are equivalent to the LEV II standards), and thus, we will adopt a similar, interim in-use compliance provision for vehicles subject to these new federal standards. As with the LEV II program, this provision will enable manufacturers to make adjustments for unforeseen problems that may occur in-use during the first three years of a new evaporative

family. We believe that a three-year period is enough time to resolve these problems, because it allows manufacturers to gain real world experience and to make adjustments to a vehicle within a typical product cycle.

Depending on the vehicle weight class and type of test, the Tier 2 certification standards are 1.3 to 1.9 times the LEV II certification standards. On average the Tier 2 standards are 1.51 times the LEV II certification standards. Thus, to maintain the same level of stringency for the in-use evaporative emission standards provided by the Tier 2 program, we will apply the Tier 2 standards in-use for only the first three model years after an evaporative family is first certified under today's new standards, instead of using the LEV II 1.75 multiplier approach described above. Since the new evaporative emission certification standards (equivalent to LEV II standards) will be implemented in model year 2009 for LDVs/LLDTs and model year 2010 for HLDTs/MDPVs, these same certification standards will apply in-use beginning in model year 2012 for LDVs/LLDTs and model year 2013 for HLDTs/MDPVs.¹⁶⁷ The schedule for in-use evaporative emissions standards are shown in Tables V.C.-3 and V.C.-4 below.

TABLE V.C-3.—SCHEDULE FOR IN-USE EVAPORATIVE EMISSION STANDARDS FOR LDVs/LLDTs

Model year of introduction	2009	2010	2011
Models Years That Tier 2	2009	2010	2011

¹⁶⁴ California Air Resources Board, "LEV II" and "CAP 2000" Amendments to the California Exhaust and Evaporative Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles, and to the Evaporative Emission Requirements for Heavy-Duty Vehicles, Final Statement of Reasons, September 1999.

¹⁶⁵ 1.75 times the 3-day diurnal plus hot soak and 2-day diurnal plus hot soak standards.

¹⁶⁶ For example, evaporative families first certified to LEV II standards in the 2005 model year shall meet in-use standards of 1.75 times the evaporative certification standards for 2005, 2006, and 2007 model year vehicles.

¹⁶⁷ For example, evaporative families first certified to the new LDV/LLDT evaporative emission standards in the 2011 model year will be required to meet the Tier 2 LDV/LLDT evaporative

emission standards in-use for 2011, 2012, and 2013 model year vehicles (applying Tier 2 standards in-use will be limited to the first three years after introduction of a vehicle), and 2014 and later model year vehicles of such evaporative families will be required to meet the new LDV/LLDT evaporative emission standards in-use.

TABLE V.C-3.—SCHEDULE FOR IN-USE EVAPORATIVE EMISSION STANDARDS FOR LDVs/LLDTs—Continued

Model year of introduction	2009	2010	2011
Standards Apply to In-use Vehicles	2010 2011	2011 2012	2012 2013

TABLE V.C-4.—SCHEDULE FOR IN-USE EVAPORATIVE EMISSION STANDARDS FOR HLDTs/MDPVs

Model year of introduction	2010	2011	2012
Models Years That Tier 2 Standards Apply to In-use Vehicles	2010 2011 2012	2011 2012 2013	2012 2013 2014

5. Existing Differences Between California and Federal Evaporative Emission Test Procedures

As described above, the levels of the California LEV II evaporative emission standards are seemingly more stringent than EPA's Tier 2 standards, but due to differences in California and EPA evaporative test requirements, EPA and most manufacturers view the programs as similar in stringency. The Tier 2 evaporative program requires manufacturers to certify the durability of their evaporative emission systems using a fuel containing the maximum allowable concentration of alcohols (highest alcohol level allowed by EPA in the fuel on which the vehicle is intended to operate, i.e., a "worst case" test fuel). Under current requirements, this fuel would be about 10 percent ethanol by volume.¹⁶⁸ We are retaining these Tier 2 durability requirements for the new evaporative emissions program. California does not require this provision. To compensate for the increased vulnerability of system components to alcohol fuel, manufacturers have indicated that they will produce a more durable evaporative emission system than the Tier 2 numerical standards would imply, using the same low permeability hoses and low loss connections and seals planned for California LEV II vehicles.

As shown in Table V.C-3, in addition to the maximum alcohol fuel content for durability testing, the other key differences between the federal and California test requirements are fuel volatilities, diurnal temperature cycles, and running loss test temperatures.¹⁶⁹ The EPA fuel volatility requirement is 2 psi greater than that of California. The

high end of EPA's diurnal temperature range is 9° F lower than that of California. Also, EPA's running loss temperature is 10° F lower than California's.

TABLE V.C-3.—DIFFERENCES IN TIER 2 AND LEV II EVAPORATIVE EMISSION TEST REQUIREMENTS

Test Requirement	EPA Tier 2	California LEV II
Fuel volatility (Reid Vapor Pressure in psi):	9	7
Diurnal temperature cycle (degrees F):	72-96	65-105
Running loss test temperature (degrees F):	95	105

Currently, California accepts evaporative emission results generated on the federal test procedure (using federal test fuel), because available data indicates the federal procedure to be a "worst case" procedure. In addition, manufacturers can currently obtain federal evaporative certification based upon California results (meeting LEV II standards under California fuels and test conditions), if they obtain advance approval from EPA.¹⁷⁰

Auto manufacturers commented that meeting the new standards can be achieved more effectively if they are provided greater flexibility in the certification process. They recommended that EPA allow federal evaporative certification to the new standards, which are equivalent to California's LEV II standards, through California evaporative testing results without obtaining advance approval. Since we are harmonizing federal evaporative standards with the LEV II evaporative emission standards in today's rule, we believe that for the new standards it is unnecessary to continue to require this advance approval for

California results. Thus, we are finalizing provisions that would allow certification to the new evaporative emission standards in accordance with California test conditions and test procedures without pre-approval from EPA.

D. Additional Exhaust Control Under Normal Conditions

We received comments recommending that EPA harmonize exhaust emissions standards with the California LEV II program. We also received comments from manufacturers stating that more stringent tailpipe standards beyond Tier 2 were not warranted and that the difference between Tier 2 and LEV II would not be meaningful. As discussed in the proposal (71 FR 15856), we did not propose to further align the federal light-duty exhaust emissions control program with that of California. We continue to believe, for reasons discussed below, that it would not be appropriate to adopt more stringent tailpipe standards under normal test conditions beyond those contained in Tier 2. It is possible that a future evaluation could result in EPA reconsidering the option of harmonizing the Tier 2 program with California's LEV-II program or otherwise seeking emission reductions beyond those of the Tier 2 program and those being finalized today.¹⁷¹ A full analysis of the comments is available in the Summary and Analysis of Comments document for this final rule.

As explained earlier, section 202(l)(2) requires EPA to adopt regulations that contain standards which reflect the greatest degree of emissions reductions achievable through the application of technology that will be available, taking into consideration existing motor

¹⁶⁸ Manufacturers are required to develop deterioration factors using a fuel that contains the highest legal quantity of ethanol available in the U.S.

¹⁶⁹ Running loss emissions means evaporative emissions as a result of sustained vehicle operation (average trip in an urban area) on a hot day. The running loss test requirement is part of the 3-day diurnal plus hot soak test sequence.

¹⁷⁰ Currently, EPA may require comparative data from both federal and California tests.

¹⁷¹ See *Sierra Club v. EPA*, 325 F. 3d at 480 (EPA can reasonably determine that no further reductions in MSATs are presently achievable due to uncertainties created by other recently promulgated regulatory provisions applicable to the same vehicles).

vehicle standards, the availability and costs of the technology, and noise, energy and safety factors. The cold temperature NMHC program finalized today is appropriate under section 202(l)(2) as a near-term control: that is, a control that can be implemented relatively soon and without disruption to the existing vehicle emissions control program. We did not propose additional long-term controls (i.e., controls that require longer lead time to implement) because we lack the information necessary to assess their appropriateness. We believe it will be important to address the appropriateness of further MSAT controls in the context of compliance with other significant vehicle emissions regulations (discussed below).

In the late 1990's both the EPA and the California Air Resources Board finalized new and technologically challenging light-duty vehicle/truck emission control programs. The EPA Tier 2 program focuses on reducing NO_x emissions from the light-duty fleet. In contrast, the California LEV-II program focuses primarily on reducing hydrocarbons by tightening the light-duty nonmethane organic gas (NMOG) standards.¹⁷² Both programs will require the use of hardware and emission control strategies not used in the fleet under previously existing programs. Both programs will achieve significant reductions in emissions. Taken as a whole, the Tier 2 program presents the manufacturers with significant engineering challenges in the coming years. Manufacturers must bring essentially all passenger vehicles under the same emission control program regardless of their size, weight, and application. The Tier 2 program represents a comprehensive, integrated package of exhaust, evaporative, and fuel quality standards which will achieve significant reductions in NMHC, NO_x, and PM emissions from all light-duty vehicles in the program. These reductions will include significant reductions in MSATs. Emission control in the Tier 2 program will be based on the widespread implementation of advanced catalyst and related control system technology. The standards are very stringent and will require manufacturers to make full use of nearly all available emission control technologies.

Today, the Tier 2 program remains in its phase-in. Cars and lighter trucks will

be fully phased into the program with the 2007 model year, and the heavier trucks won't be fully entered into the program until the 2009 model year. Even though the lighter vehicles will be fully phased in by 2007, we expect the characteristics of this segment of the fleet to remain in a state of transition at least through 2009, because manufacturers will be making adjustments to their fleets as the larger trucks phase in. The Tier 2 program is designed to enable vehicles certified to the LEV-II program to cross over to the federal Tier 2 program. At this point in time, however, it is difficult to predict the degree to which this will occur. The fleetwide NMOG levels of the Tier 2 program will ultimately be affected by the manner in which LEV-II vehicles are certified within the Tier 2 bin structure, and vice versa. We intend to carefully assess these two programs as they evolve and periodically evaluate the relative emission reductions and the integration of the two programs.

Today's final rule addresses toxics emissions from vehicles operating at cold temperatures. The technology to achieve this is already available and we project that compliance will not be costly. However, we do not believe that we could reasonably propose further controls at this time. There is enough uncertainty regarding the interaction of the Tier 2 and LEV-II programs to make it difficult to evaluate today what might be achievable in the future. Depending on the assumptions one makes, the LEV-II and Tier 2 programs may or may not achieve very similar NMOG emission levels. Therefore, the eventual Tier 2 baseline technologies and emissions upon which new standards would necessarily be based are not known today. Additionally, we believe it is important for manufacturers to focus in the near term on developing and implementing robust technological responses to the Tier 2 program without the distraction or disruption that could result from changing the program in the midst of its phase-in. We believe that it may be feasible in the longer term to seek additional emission reductions from the base Tier 2 program, and the next several years will allow an evaluation based on facts rather than assumptions. For these reasons, we are deferring a decision on seeking additional NMOG reductions from the base Tier 2 program.

E. Vehicle Provisions for Small Volume Manufacturers

Before issuing a proposal for this rulemaking, we analyzed the potential impacts of these regulations on small entities. As a part of this analysis, we

convened a Small Business Advocacy Review Panel (SBAR Panel, or "the Panel"). During the Panel process, we gathered information and recommendations from Small Entity Representatives (SERs) on how to reduce the impact of the rule on small entities, and those comments are detailed in the Final Panel Report which is located in the public record for this rulemaking (Docket EPA-HQ-OAR-2005-0036). Based on these comments, we proposed lead time transition and hardship provisions that will be applicable to small volume manufacturers as described below in section V.E.1 and V.E.2. For further discussion of the Panel process, see section XII.C of this rule and/or the Final Panel Report. We received no comments on this section in response to the proposed rulemaking.

As discussed in more detail in section XII.C, in addition to the major vehicle manufacturers, three distinct categories of businesses relating to highway light-duty vehicles would be covered by the new vehicle standards: small volume manufacturers (SVMs), independent commercial importers (ICIs),¹⁷³ and alternative fuel vehicle converters.¹⁷⁴ We define small volume manufacturers as those with total U.S. sales less than 15,000 vehicles per year, and this status allows vehicle models to be certified under a slightly simpler certification process. For certification purposes, SVMs include ICIs and alternative fuel vehicle converters since they sell less than 15,000 vehicles per year.

About 34 out of 50 entities that certify vehicles are SVMs, and the Panel identified 21 of these 34 SVMs that are small businesses as defined by the Small Business Administration criteria (5 manufacturers, 10 ICIs, and 6 converters). Since a majority of the SVMs are small businesses and all SVMs have similar characteristics as described below in section V.E.1, the Panel recommended that we apply the lead time transition and hardship provisions to all SVMs. These manufacturers represent just a fraction of one percent of the light-duty vehicle and light-duty truck sales. Our final rule today is consistent with the Panel's recommendation.

¹⁷³ ICIs are companies that hold a Certificate (or certificates) of Conformity permitting them to import nonconforming vehicles and to modify these vehicles to meet U.S. emission standards.

¹⁷⁴ Alternative fuel vehicle converters are businesses that convert gasoline or diesel vehicles to operate on alternative fuel (e.g., compressed natural gas), and converters must seek a certificate for all of their vehicle models.

¹⁷² NMOG includes emissions of nonmethane hydrocarbons plus all other nonmethane organic air pollutants (for example, aldehydes), which are ozone precursors. For gasoline and diesel vehicles, NMHC and NMOG emissions levels are very similar.

1. Lead Time Transition Provisions

In these types of vehicle businesses, predicting sales is difficult and it is often necessary to rely on other entities for technology (see earlier discussions in section V on technology needed to meet the new standards).^{175 176} Moreover, percentage phase-in requirements pose a dilemma for an entity such as an SVM that has a limited product line. For example, it is challenging for an SVM to address percentage phase-in requirements if the manufacturer makes vehicles in only one or two test groups. Because of its very limited product lines, a SVM could be required to certify all their vehicles to the new standards in the first year of the phase-in period, whereas a full-line manufacturer (or major manufacturer) could utilize all four years of the phase-in. Thus, similar to the flexibility provisions implemented in the Tier 2 rule, the Panel recommended that we allow SVMs (includes all vehicle small entities that would be affected by this rule, which are the majority of SVMs) the following options for meeting cold temperature NMHC standards and evaporative emission standards as an element of determining appropriate lead time for these entities to comply with the standards.

For cold NMHC standards, the Panel recommended that SVMs simply comply with the standards with 100 percent of their vehicles during the last year of the four-year phase-in period. Since these entities could need additional lead time and the new standards for LDVs and LLDTs would begin in model year 2010 and would end in model year 2013 (25%, 50%, 75%, 100% phase-in over four years), we are finalizing, as proposed, a provision requiring only that SVMs certify 100 percent of their LDVs and LLDTs in model year 2013. Also, since the new standard for HLDTs and MDPVs would start in 2012 (25%, 50%, 75%, 100% phase-in over four years), we are finalizing, again as proposed, a provision requiring that the SVMs certify 100 percent of their HLDTs and MDPVs in model year 2015.

In regard to evaporative emission standards, the Panel recommended that

since the new evaporative emissions standards would not have phase-in years, we allow SVMs to simply comply with standards during the third year of the program. We have implemented similar provisions in past rulemakings. Given the additional challenges that SVMs face, as noted above, we believe that this recommendation is reasonable. Therefore, for a 2009 model year start date for LDVs and LLDTs, we are finalizing, as proposed, a provision requiring that SVMs meet the evaporative emission standards in model year 2011. For a model year 2010 implementation date for HLDTs and MDPVs, we are finalizing the proposed provision requiring that SVMs comply in model year 2012.

2. Hardship Provisions

In addition, the Panel recommended that case-by-case hardship provisions be extended to SVMs for the cold temperature NMHC and evaporative emission standards as an aspect of determining the greatest emission reductions feasible. These entities could, on a case-by-case basis, face hardship more than major manufacturers (manufacturers with sales of 15,000 vehicles or more per year), and we are finalizing as proposed this provision to provide what could prove to be a needed safety valve for these entities. SVMs will be allowed to apply for up to an additional 2 years to meet the 100 percent phase-in requirements for cold NMHC and the delayed requirement for evaporative emissions. As with hardship provisions for the Tier 2 rule, we are finalizing, as proposed, a provision providing that applications for such hardship relief must be made in writing, must be submitted before the earliest date of noncompliance, must include evidence that the noncompliance will occur despite the manufacturer's best efforts to comply, and must include evidence that severe economic hardship will be faced by the company if the relief is not granted.

We will work with the applicant to ensure that all other remedies available under this rule are exhausted before granting additional relief. To avoid any perception that the existence of the hardship provision could prompt SVMs to delay development, acquisition and application of new technology, we want to make clear that we expect this provision to be rarely invoked, and that relief would rarely be granted. Today's rule contains numerous flexibilities for all manufacturers and it delays implementation dates for SVMs. We would expect SVMs to prepare for the

applicable implementation dates in today's rule.

3. Special Provisions for Independent Commercial Importers (ICIs)

Although the SBAR panel did not specifically recommend it, we are finalizing as proposed provisions allowing ICIs to participate in the averaging, banking, and trading program for cold temperature NMHC fleet average standards (as described in Table IV.B.-1), but with appropriate constraints to ensure that fleet averages will be met. The existing regulations for ICIs specifically prohibit ICIs from participating in emission-related averaging, banking, and trading programs unless specific exceptions are provided (see 40 CFR 85.1515(d)). The concern is that they may not be able to predict their sales and control their fleet average emissions because they are dependent upon vehicles brought to them by individuals attempting to import uncertified vehicles. However, an exception for ICIs to participate in an averaging, banking, and trading program was made for the Tier 2 NO_x fleet average standards (65 FR 6794, February 10, 2000), and today we are finalizing, as proposed, a similar exception for the cold temperature NMHC fleet average standards.

If an ICI is able to purchase credits or to certify a test group to a family emission level (FEL) below the applicable cold temperature NMHC fleet average standard, the rule allows the ICI to bank credits for future use. Where an ICI desires to certify a test group to a FEL above the applicable fleet average standard, the rule allows them to do so if they have adequate and appropriate credits. Where an ICI desires to certify to an FEL above the fleet average standard and does not have adequate or appropriate credits to offset the vehicles, we will permit the manufacturer to obtain a certificate for vehicles using such a FEL, but will condition the certificate such that the manufacturer can only produce vehicles if it first obtains credits from other manufacturers or from other vehicles certified to a FEL lower than the fleet average standard during that model year.

Our experience over the years through certification indicates that the nature of the ICI business is such that these companies cannot predict or estimate their sales of various vehicles well. Therefore, we do not have confidence in their ability to certify compliance under a program that will allow them leeway to produce some vehicles to a higher FEL now but sell vehicles with lower FELs later, such that they were able to

¹⁷⁵ For example, as described later in section V.E.3, ICIs may not be able to predict their sales because they are dependent upon vehicles brought to them by individuals attempting to import uncertified vehicles.

¹⁷⁶ SVMs (those with sales less than 15,000 vehicles per year) include ICIs, alternative fuel vehicle converters, companies that produce specialty vehicles by modifying vehicles produced by others, and companies that produce small quantities of their own vehicles, but rely on major manufacturers for engines and other vital emission related components.